


CA2ALA 25  
70 S73  
c.1

CA2 ALA 25 1970S73  
Surface Irrigation Evaluation - Bow Island Test Plots, June 5, 1970. 1



3 3398 00128 9601

LIBRARY  
VAULT 19

To



SURFACE IRRIGATION EVALUATION  
BOW ISLAND TEST PLOTS



ALBERTA DEPARTMENT OF AGRICULTURE  
WATER RESOURCES DIVISION  
LETHBRIDGE REGION









TABLE OF CONTENTS

Page No.

History-----	1
Study Area-----	2
Soils-----	6
Procedures-----	8
Results-----	9
Soils-----	9
Crop-----	10
Soil Evaluation-----	17
Watering Profiles-----	17
Watering-----	20
Conclusions-----	21
Recommendations-----	23
References-----	24
Appendix-----	
Figures-----	

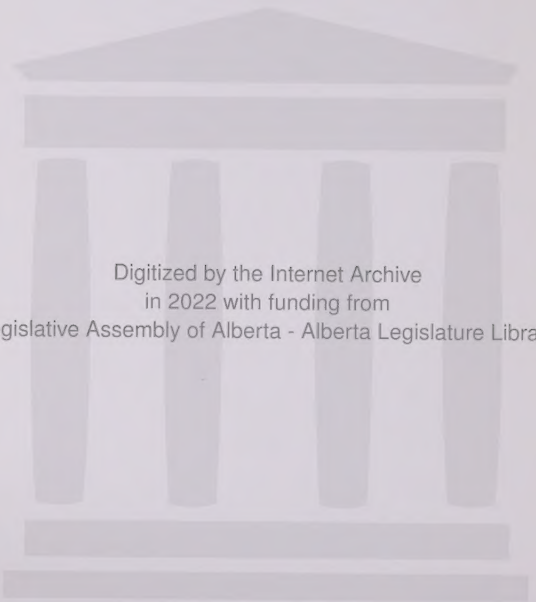
SURFACE IRRIGATION EVALUATION  
BOW ISLAND TEST PLOTS

Alberta Department of Agriculture  
Water Resources Division  
Agrohydrology Branch

Prepared by: Glen L. Steed  
Thomas A. Androsoff

Date: June 5th, 1970





Digitized by the Internet Archive  
in 2022 with funding from

Legislative Assembly of Alberta - Alberta Legislature Library

## TABLE OF CONTENTS

	Page No.
History-----	1
Study Area-----	2
Soils-----	6
Procedure-----	6
Results	
Soils-----	9
Crop-----	10
Border Evaluation-----	17
Wetting Profiles-----	17
Structure Analysis-----	20
Conclusions-----	21
Recommendations-----	23
References-----	24
Appendix-----	
Figures-----	



## LIST OF TABLES

### Page No.

Bow Island Plots Soil Analysis	
- Fertility Levels 1968 (Fall)-----	3

Mechanical Analysis of Soils	
- Bow Island Plots-----	7

Single Ring Infiltrometer Tests,	
Bow Island Plots - 1967-----	11

Relations of Yields and Soil Chemistry	
- Bow Island Plots - August, 1969-----	12

Water Holding Capacity Analysis	
- Bow Island Plots-----	14





## SURFACE IRRIGATION EVALUATION BOW ISLAND TEST PLOTS

The need to know more about the efficiency of a levelled surface irrigation system relative to the influences of downfield profile changes on wetting patterns and distribution in general of the water in the soil profile prompted the following study.

Through agreement with the Canada Department of Forestry an A.R.D.A. project, Project No. 28047, was instituted to study the influences of downfield slope on wetting patterns and evaluate various criteria (infiltration, consumptive use, and farm delivery ditches, structures, etc.). The objectives as they were originally outlined are contained in the appendix (see Appendix A) to this report. It should be realized that although the objectives were outlined, not all can be achieved in one year of initial study.

### HISTORY

The study was initiated in 1966-67 season with construction of the levelled borders. The following year saw the construction of the concrete-lined delivery ditch to the south end of the plot area. Because of the close proximity of the plots to a deep coulee it was necessary to provide some protection against slope erosion from waste water from the plots. Due to the press of other construction needs in 1968-69 these drop structures were not installed until April and May of 1969. During the summer of 1968 some preliminary tests were made but because of the need to control all waste water and prevent any running down into the coulee the tests were only of a preliminary nature and contributed little to the study.

In the early spring of 1969 the heavy growth of weeds (Russian





thistle) on the test plots was raked and burned to facilitate proper farm operation of the plots in the summer of 1969. In April 1969 oats were seeded over the entire area as an initial crop. Tests were made of the fertilizer requirements (Table 1, Figure 1) on the area and many parts of the test plots were low in fertility. An application of 100 lbs. per acre of 16-20-0 was applied to the full area. The oat crop was harvested as greenfeed and grass (brome, white dutch clover and Kentucky Bluegrass) seeded in the stubble.

Following seeding of oats, neutron access tubes, moisture blocks (Coleman - fiberglass) and tensiometers were installed at a number of locations in the plot area. To prevent surface compaction of the plot area, aerial spraying of new Russian thistle was carried out in the spring of 1969.

In the summers of 1968 and 1969, preliminary tests were conducted on the test plots and consisted of single ring infiltrometer determinations of infiltration rates (1968), and border dyke evaluation tests, and evaluation and mapping of growth patterns for the oats (1969). Due to a limitation on time, equipment and personnel, studies were conducted on only fields #1 and #2 in 1969.

Two benches in the northwest corner of field #3 were left in a bare condition. The area was used for studies of soil erosion under irrigation for a M.Sc. thesis by F. Adeniji (1).

#### STUDY AREA

The site selected for the study is located approximately six miles north of Bow Island and adjacent to the Provincial Lands and Forests grazing reserve. (See Figure 2). The fields were designed





TABLE 1      BOW ISLAND PLOTS SOIL ANALYSIS - FERTILITY LEVELS  
1968 (FALL)

Hole No.	Depth (In.)	Parts/Million		Pounds/Acre		Oat Crop Rating 1969
		NO <sub>3</sub>	P	NO <sub>3</sub>	P	
1	0 - 6	62.0	0.50	28	1.0	Good
	6 - 12	168.0	1.10	75	2.2	
2	0 - 6	44.2	0.90	20	1.8	Good
	6 - 12	39.8	1.80	18	3.6	
3	0 - 6	110.8	0.80	49	1.6	Average
	6 - 12	137.0	3.00	62	6.0	
4	0 - 6	115.0	0.9	52	1.8	Average
	6 - 12	156.0	3.8	70	7.6	
5	0 - 6	91.2	2.8	41	5.6	Good
	6 - 12	44.2	2.4	20	4.8	
6	0 - 6	50.6	1.2	22	2.4	Average
	6 - 12	30.0	4.0	13	8.0	
7	0 - 6	55.2	3.1	25	6.2	Average
	6 - 12	34.6	0.4	15	0.8	
8	0 - 6	-	2.8	-	5.6	Poor
	6 - 12	8.9	2.7	4	5.4	
9	0 - 6	70.8	0.4	32	0.8	Good
	6 - 12	50.4	3.6	22	7.2	
10	0 - 6	84.0	1.1	38	2.2	Good
	6 - 12	42.6	0.6	19	1.2	
11	0 - 6	23.0	0.2	10	0.4	Poor
	6 - 12	26.6	0.2	12	0.4	
12	0 - 6	55.2	4.7	25	9.4	Average
	6 - 12	53.2	0.5	24	1.0	
13	0 - 6	97.4	4.4	44	8.8	Average
	6 - 12	70.8	1.2	32	2.4	
14	0 - 6	22.0	1.9	10	3.8	Good
	6 - 12	-	0.6	-	1.2	
15	0 - 6	27.4	2.8	12	5.6	Good
	6 - 12	26.6	0.4	12	0.8	





TABLE 1      BOW ISLAND PLOTS SOIL ANALYSIS - FERTILITY LEVELS  
1968 (FALL)

Hole No.	Depth (In.)	Parts/Million		Pounds/Acre		Oat Crop Rating 1969
		NO <sub>3</sub>	P	NO <sub>3</sub>	P	
16	0 - 6	13.3	0.5	6	1.0	Average
	6 - 12	17.7	0.4	8	0.8	
17	0 - 6	22.0	1.4	10	2.8	Average
	6 - 12	20.4	1.0	9	2.0	
18	0 - 6	86.0	0.5	38	1.0	Average
	6 - 12	26.6	0.14	12	0.3	
19	0 - 6	199.0	0.2	90	0.4	Average
	6 - 12	124.0	0.14	56	0.3	
20	0 - 6	15.1	2.0	7	4.0	Good
	6 - 12	31.0	4.0	14	8.0	
21	0 - 6	119.8	4.7	54	9.4	Good
	6 - 12	50.4	4.7	22	9.4	
22	0 - 6	19.5	4.4	9	8.8	Average
	6 - 12	6.6	3.6	3	7.2	
23	0 - 6	19.5	5.4	9	10.8	Average
	6 - 12	-	0.4	-	0.8	
24	0 - 6	17.7	3.8	8	7.6	Good
	6 - 12	10.6	3.6	5	7.2	
25	0 - 6	142.0	1.8	64	3.6	Good
	6 - 12	31.0	2.7	14	5.4	
26	0 - 6	-	0.2	-	0.4	Good
	6 - 12	66.4	0.2	30	0.4	
27	0 - 6	46.0	0.5	20	1.0	Average
	6 - 12	17.7	0.4	8	0.8	
28	0 - 6	31.0	1.0	13	2.0	Average
	6 - 12	13.3	0.4	6	0.8	
29	0 - 6	31.0	5.0	13	10.0	Average
	6 - 12	17.7	4.0	8	8.0	
30	0 - 6	53.2	3.6	23	7.2	Average
	6 - 12	108.4	4.3	47	8.6	





TABLE 1      BOW ISLAND PLOTS SOIL ANALYSIS - FERTILITY LEVELS  
1968 (FALL)

Hole No.	Depth (In.)	Parts/Million		Pounds/Acre		Oat Crop Rating 1969
		NO <sub>3</sub>	P	NO <sub>3</sub>	P	
31	0 - 6	55.0	5.2	24	10.4	Average
	6 - 12	57.6	4.4	25	8.8	
32	0 - 6	35.6	3.6	15	7.2	Average
	6 - 12	39.8	0.8	17	1.6	
33	0 - 6	124.0	0.4	53	0.8	Average
	6 - 12	71.0	2.6	31	5.2	
34	0 - 6	22.2	0.2	10	0.4	Average
	6 - 12	20.4	0.14	9	0.3	
35	0 - 6	40.0	4.6	17	9.2	Average
	6 - 12	12.4	4.3	5	8.6	
36	0 - 6	15.1	5.2	7	10.4	Average
	6 - 12	8.9	4.0	4	8.0	
37	0 - 6	66.4	3.9	28	7.8	Average
	6 - 12	39.8	0.14	17	0.3	
38	0 - 6	90.6	2.8	40	5.6	Average
	6 - 12	84.0	4.0	36	8.0	
39	0 - 6	99.2	0.2	42	0.4	Average
	6 - 12	53.2	0.4	23	0.8	
40	0 - 6	42.2	0.6	18	1.2	Good
	6 - 12	26.6	0.14	11	0.3	
41	0 - 6	75.4	2.3	33	4.6	Good
	6 - 12	39.8	4.2	17	8.4	
42	0 - 6	129.2	2.7	56	5.4	Average
	6 - 12	77.6	2.0	33	4.0	
43	0 - 6	79.8	2.0	35	4.0	Average
	6 - 12	39.0	0.8	17	1.6	
44	0 - 6	123.0	4.6	54	9.2	Average
	6 - 12	8.9	1.2	38	2.4	
45	0 - 6	104.0	5.6	45	11.2	Average
	6 - 12	44.4	2.0	19	4.0	



using fifteen benches to incorporate varying lengths, slopes and slope changes (concave, convex). (See Figures 3, 4, 5, 6). Each bench was divided into 25-foot borders and the third and fourth border of each bench was corrugated (24-inch and 30-inch spacings).

The delivery system (see Figure 7) incorporated a concrete head ditch along the south side and 18-inch plastic tubing (flexible) for delivery to the secondary earth ditch supplying field #3.

### SOILS

Prior to levelling, the area was given an intensive soil survey. The survey indicated that in general soils were coarse to moderately coarse in texture. Construction was considered desirable based on the fact that not only irrigation efficiencies and design criteria would be evaluated but that grazing systems and economics of grazing reserves would be the major additional part of the study. (See Appendix A).

After levelling, a great variability in the soil profiles resulted (see Figure 8). This is, however, a realistic situation for the study as profile mixing and variations, such as found on the plots, are typical of levelled land in Alberta.

Mechanical analysis of the soils (see Table 2, Figure 1) showed that the soils were of finer texture than had been originally textured by hand methods with a predominance of loams and sand loams.

### PROCEDURE

Following levelling, an additional soil survey based on acid bottle tests was made to determine the variability in the chemistry





TABLE 2

MECHANICAL ANALYSIS OF SOILS - BOW ISLAND PLOTS

Sample No.	Depth (In.)	Sand %	Clay %	Silt %	Texture
C3	0 - 6	47.4	20.6	32.0	Loam
	6 - 12	43.4	22.2	34.4	Loam
C5	0 - 6	47.0	19.6	33.4	Loam
	6 - 12	57.0	18.8	24.2	Sandy Loam
C6	0 - 6	45.8	19.6	34.6	Loam
	6 - 12	48.6	19.8	31.6	Loam
C10	0 - 6	59.4	17.6	23.0	Sandy Loam
	6 - 12	45.4	21.8	32.8	Loam
C11	0 - 6	71.8	13.6	14.6	Sandy Loam
	6 - 12	67.8	17.6	14.6	Sandy Loam
C12	0 - 6	51.6	18.0	30.4	Loam
	6 - 12	57.8	17.8	24.4	Sandy Loam
C15	0 - 6	50.4	19.8	29.8	Loam
	6 - 12	41.4	23.4	35.2	Loam
C16	0 - 6	67.8	13.6	18.6	Sandy Loam
	6 - 12	80.2	9.8	10.0	Loamy Sand
C19	0 - 6	58.8	15.8	25.4	Sandy Loam
	6 - 12	55.8	16.6	27.6	Sandy Loam
C21	0 - 6	55.8	17.8	26.4	Sandy Loam
	6 - 12	57.2	17.6	25.2	Sandy Loam
C29	0 - 6	50.8	19.2	30.0	Loam
	6 - 12	52.6	19.6	27.8	Loam
C30	0 - 6	47.4	20.0	32.6	Loam
	6 - 12	41.0	22.6	36.4	Loam
C31	0 - 6	48.0	21.8	30.2	Loam
	6 - 12	46.2	21.6	32.2	Loam
C32	0 - 6	44.8	23.4	31.8	Loam
	6 - 12	51.0	21.4	27.6	Loam-Sandy Clay Loam
C33	0 - 6	53.8	19.4	26.8	Loam
	6 - 12	51.4	19.8	28.8	Loam
C34	0 - 6	54.8	19.4	25.8	Sandy Clay Loam
	6 - 12	47.8	22.0	30.2	Loam
C40	0 - 6	46.0	24.2	29.8	Loam
	6 - 12	39.4	27.2	33.4	Loam
C42	0 - 6	50.6	19.8	29.6	Loam
	6 - 12	28.2	26.2	45.6	Loam
C45	0 - 6	49.8	22.0	28.2	Loam
	6 - 12	58.4	21.6	20.0	Sandy Clay Loam





(lime) of the soils.

Single ring infiltrometer tests were made using the procedure as outlined by the S.C.S. Handbook 82. (2)

Border evaluation tests to determine the overall wetting and efficiencies of the system were determined on a number of borders. Procedure was basically an inflow - outflow measurement and moisture determinations at various stations down the slope before and after irrigation. The stream size was based on available storage, infiltration rate, slope of the border and length to be irrigated.

Due to a delay in drain construction for the plots, the first irrigation was not started until June 9th. The second border of every bench was used for border irrigation evaluation tests along with soil moisture monitoring. All borders were irrigated with 3 inches applied by the first irrigation and a 4-inch application with the next irrigation of July 7th - 18th.

To provide adequate meteorological data for the test area, the following equipment was set up adjacent to the plots:

- a) Maximum and minimum thermometers
- b) Radiometer
- c) Evaporimeters (Class "A" Pan and Gen)
- d) Ground anemometer
- e) Tower (30-foot) anemometer
- f) Hygrothermograph

NOTE: The data from these instruments is on file with the Agrohydrology Branch, Lethbridge.

To monitor soil moisture and wetting patterns, tensiometers,



soil moisture blocks and neutron meter access tubes were installed at various sites (see Figure 9). These were installed at the upper and lower ends of major slopes and at one other station between. The location of the instruments in this way was to monitor the effects of slope changes, concave and convex, on the wetting profiles and the profiles on long continuous slopes.

Readings of the neutron access tubes, moisture blocks and tensiometers were made at periodic intervals during the growing season. This was supplemented by rainfall and evaporation records and wind records from a Class "A" meteorological station installed at the test site. The neutron meter was calibrated to the soils using the method outlined by Luebs, et al. (3)

Soil moisture blocks were calibrated to the soils using samples taken at the specific sites and depths. The readings were made through three wetting-drying cycles.

## RESULTS

Results of the 1969 crop year studies are not too extensive as the cleaning up of the land, reseeding to oats, etc. did not provide an excellent opportunity for full studies to be carried out.

### A. Soils

Results of mechanical analysis (Table 2) indicate a more uniform texturing of the soils than was indicated by the drill log survey. Of the 38 samples analysed, 1 was loamy sand, 10 were sandy loam, 24 were loam, 1 was loam sandy loam and 2 were sandy clay loam. Very little of the area was in the finer textured class.

Infiltration tests made with the single ring infiltrometer





showed a great deal of variability. (See Table 3). There was no correlation between cut and fill and basic intake rate nor between texture and intake rate. As can be seen from Table 3 there is not an indication of modification of basic intake rate with combinations of fill or cut and soil textures.

The results showed good infiltration over the total area with infiltration values varying from 0.12 inches per hour to 1.60 inches per hour with the average at 0.65 inches per hour.

Analysis using a 10% HCL solution indicated areas of high lime. (Figure 10). Reference to Table 4 indicates no extensive areas of high lime. The pH values are 7.2 or higher and the highest was 8.3 indicating no extreme acidic or basic condition. Sample locations are shown on Figure 11.

Soil water holding capacities were determined for a number of plot sites. The results presented in Table 5 outline the bulk density values and the plant available moisture amounts for the soils. Water holding capacity values were determined by pressure equipment and Richards (4) procedures.

The values of plant available moisture range from 2.75 inches to 6.74 inches for a 4-foot root zone. The major grouping of values is around a value of 5.68 inches for the 4-foot root zone.

#### B. Crop

Random yield sampling of green oat hay crop was rated good, average and poor. The following yield values were found representative of the three classes:





TABLE 3

## SINGLE RING INFILTROMETER TESTS, BOW ISLAND PLOTS - 1967

Bench	Location		Basic Intake Rate (in./hr)	Soil Texture Class*	Levelled Condition (x)	1969 Oat Crop Rating
	Border	Station				
1	3	1+00 5+00	0.28 0.30	Medium Moderately Coarse	Cut Cut	Good Good
2	3	1+00 5+00 9+00	0.26 0.38 0.30	Medium Medium Moderately Coarse	Cut Fill Fill	Average Average Average
3	1	1+00 5+00 9+00	0.44 0.70 0.62	Moderately Coarse Medium Moderately Coarse	Cut Fill Fill	Average Good Poor
4	1	1+00 5+00 9+00	0.12 0.85 0.68	Medium Coarse Moderately Fine	Cut Fill Cut	Average Poor Poor
5	1	1+00 5+00 9+00	0.80 1.20 1.60	Medium Moderately Coarse Coarse	Cut Fill Fill	Good Poor Poor
6	1	1+00 5+00 9+00	0.13 0.80 0.80	Moderately Coarse Moderately Coarse Moderately Coarse	Cut Fill Fill	Average Poor Poor
9	1	0+50 1+70 3+40	0.50 1.40 0.85	Moderately Coarse Moderately Coarse Moderately Coarse	Cut Cut Cut	Average Average Average

\* Coarse Textured - CS, MS, FS, VFS, LCS, LMS, LFS.  
 Moderately Coarse Textured - LVFS, CSL, MSL, FSL.  
 Medium Textured - VFSL, L, SIL.  
 Moderately Fine Textured - SCL, CL, SiCL.

(x) See Figure 23.



RELATIONS OF YIELDS AND SOIL CHEMISTRY - BOW ISLAND PLOTS - AUGUST, 1969

GOOD CROP					AVERAGE CROP					POOR CROP				
Site No.	Depth (In.)	NO <sub>3</sub> P.P.M.	P P.P.M.	pH	Site No.	Depth (In.)	NO <sub>3</sub> P.P.M.	P P.P.M.	pH	Site No.	Depth (In.)	NO <sub>3</sub> P.P.M.	P P.P.M.	pH
1	0 - 6 6 - 12 12 - 24	21.0 - -	2.5 - -	7.7 7.4 7.4	3	0 - 6 6 - 12 12 - 24	41.0 - -	5.0 - -	- 7.6 7.8	7	0 - 6 6 - 12 12 - 24	11.0 - -	3.0 - -	7.9 7.9 7.6
2	0 - 6 6 - 12 12 - 24	21.0 - -	2.0 - -	7.7 7.6 7.9	4	0 - 6 6 - 12 12 - 24	21.0 - -	4.9 - -	7.7 7.7 7.7	8	0 - 6 6 - 12 12 - 24	10.0 - -	2.3 - -	8.0 7.9 8.1
5	0 - 6 6 - 12 12 - 24	8.0 - -	2.8 - -	- 7.6 -	9	0 - 6 6 - 12 12 - 24	8.0 - -	2.8 - -	- 8.0 7.8	10	0 - 6 6 - 12 12 - 24	8.0 - -	- - -	7.9 8.2 8.0
6	0 - 6 6 - 12 12 - 24	11.0 - -	2.8 - -	- 7.7 7.6	13	0 - 6 6 - 12 12 - 24	16.0 - -	1.6 - -	7.7 7.8 7.9	14	0 - 6 6 - 12 12 - 24	3.0 - -	1.4 - -	7.8 7.7 7.5
11	0 - 6 6 - 12 12 - 24	8.0 - -	- - -	7.9 7.7 7.2	16	0 - 6 6 - 12 12 - 24	6.0 - -	3.5 - -	7.7 7.7 7.6					
12	0 - 6 6 - 12 12 - 24	18.0 - -	4.6 - -	7.8 7.8 8.3	17	0 - 6 6 - 12 12 - 24	- - -	- - -	- 7.6 -					
15	0 - 6 6 - 12 12 - 24	4.0 - -	1.3 - -	7.5 7.4 7.5	18	0 - 6 6 - 12 12 - 24	5.0 - -	1.6 - -	7.6 7.7 7.8					
19	0 - 6 6 - 12 12 - 24	4.0 - -	1.6 - -	7.7 7.6 -	20	0 - 6 6 - 12 12 - 24	4.0 - -	- - -	- 7.5 7.5					





TABLE 4 (continued)

RELATIONS OF YIELDS AND SOIL CHEMISTRY - BOW ISLAND PLOTS - AUGUST, 1969

GOOD CROP					AVERAGE CROP					POOR CROP				
Site No.	Depth (In.)	NO <sub>3</sub> P.P.M.	P P.P.M.	pH	Site No.	Depth (In.)	NO <sub>3</sub> P.P.M.	P P.P.M.	pH	Site No.	Depth (In.)	NO <sub>3</sub> P.P.M.	P P.P.M.	pH
23	0 - 6	3.0	2.3	-	21	0 - 6	9.0	1.3	-					
	6 - 12	-	-	-		6 - 12	-	-	7.7					
	12 - 24	-	-	-		12 - 24	-	-	8.3					
					22	0 - 6	-	1.3	-					
						6 - 12	-	-	7.7					
						12 - 24	-	-	7.9					



TABLE 5

## WATER HOLDING CAPACITY ANALYSIS - BOW ISLAND PLOTS

Bench	Location Border	Station	Date Sampled	Depth (inches)	Bulk Density	Water Holding Capacity		Remarks
						@ 1/3 Bar	@ 15 Bars	
1	2	0+50	8/5/69	0 - 6 6 - 12 12 - 24 24 - 36 36 - 48	1.42 1.42 1.31 1.30 1.21	2.51 3.03 2.88 2.76 3.49 Total for 4' Root Zone	1.19 1.29 1.30 1.24 1.38 6.74	1969 Oat Crop - GOOD
2	2	1+00	6/28/68	0 - 6 6 - 12 12 - 24 24 - 36 36 - 48	1.44 1.44 1.54 1.39 1.44	2.57 2.26 2.20 2.94 2.82 Total for 4' Root Zone	1.16 1.04 0.95 1.15 1.37 5.80	1969 Oat Crop - AVERAGE
2	2	4+00	6/28/68	0 - 6 6 - 12 12 - 24 24 - 36 36 - 48	1.52 1.52 1.23 1.46 1.57	3.30 3.97 3.34 3.19 - **Total for 3' Root Zone	1.46 1.76 1.38 1.48 - 5.69	1969 Oat Crop - AVERAGE
3	4	1+00	8/5/69	0 - 6 6 - 12 12 - 24 24 - 36 36 - 48	1.25 1.25 1.56 1.48 1.55	- 2.24 4.48 0.95 1.45 Total for 4' Root Zone	- 0.99 1.95 1.38 0.43 5.37	1969 Oat Crop - AVERAGE
3	3	5+00	8/5/69	0 - 6 6 - 12 12 - 24 24 - 36 36 - 48	1.47 1.47 1.60 1.46 1.34	1.61 2.03 2.96 1.82 3.23 Total for 4' Root Zone	0.76 0.90 1.36 0.88 1.21 5.55	1969 Oat Crop - GOOD





TABLE 5 (continued) WATER HOLDING CAPACITY ANALYSIS - BOW ISLAND PLOTS

Location		Date Sampled	Depth (inches)	Bulk Density	Water Holding Capacity (inches)		Remarks		
Bench	Border				Station	@ 1/3 Bar		@ 15 Bars	A. M.*
4	3	4+50	7/3/68	0 - 6	1.70	1.57	0.67	0.45	1969 Oat Crop - POOR
				6 - 12	1.70	1.78	0.80	0.49	
				12 - 24	1.58	1.60	0.75	0.85	
				24 - 36	1.58	2.75	1.37	1.38	
				36 - 48	1.60	2.44	1.14	1.30	
				Total for 4' Root Zone		4.47			
3	4	4+00	8/5/69	0 - 6	1.55	1.22	0.57	0.33	1969 Oat Crop - POOR
				6 - 12	1.55	1.65	0.72	0.47	
				12 - 24	1.50	2.82	1.15	1.67	
				24 - 36	1.50	2.29	1.06	1.23	
				36 - 48	1.41	2.39	1.04	1.35	
				Total for 4' Root Zone		5.05			
6	2	6+50	8/5/69	0 - 6	1.50	1.88	1.00	0.44	1969 Oat Crop - POOR
				6 - 12	1.50	1.86	0.88	0.49	
				12 - 24	1.61	1.68	0.83	0.85	
				24 - 36	1.51	0.87	0.37	0.50	
				36 - 48	1.42	0.84	0.37	0.47	
				Total for 4' Root Zone		2.75			

\* - Available Moisture (plant available) based on sample zone.

\*\* - Note only 3' Root Zone.

(\*) - Assumed as representative for the 0 - 12" depth of soil.



good	- 4.73 tons/acre
average	- 2.20 tons/acre
poor	- 1.17 tons/acre
overall weighted average	- 3.02 tons/acre

The yield distribution (see Figure 10) showed an indication of possible yield reductions due to high surface lime. The values of pH listed in Table 4 do not show any pH values that would not fit in the pH tolerance range of oats. (See Figure 12).

Twenty-seven sites were sampled at 0 - 15 inches and the following crop-lime relationship was found:

	Profiles or Samples Taken	Profiles with mild lime at surface	Profiles with no lime at surface	Profiles with strong lime at surface	Profiles with 5" mild lime over strong lime
Good Crop	6	4	2		
Average Crop	5	5			
Poor Crop	16	2		12	2

Lime indication was found with the use of 10% HCL. It should be noted that both profiles of "poor crop - mild lime at surface" had a mild indication of lime at the surface but this was to a depth of 6 inches, where a layer of very coarse sand and gravel began.

Reference to Tables 3 and 5 show no trends or correlation between basic intake rates, textures, levelled condition or plant available moisture values. There was some indication of poor yields and coarse textured soils occurring together but this was not consistent at all locations.





### C. Border Evaluation

Although stream sizes and total times of application of water were determined based on border size, slope and soil basic intake rate, it is obvious from results illustrated in Figures 13 to 18 that the stream size was too large.

Since the applications were timed to reduce runoff from the borders the large stream did not have enough time to wet to the full root zone depth.

As can be seen from the majority of the tests the wetting depth was generally even over the lengths illustrated. It should be pointed out that additional borders were tested but only five were included in this report. These were selected as representative of the various results obtained by all borders tested.

From the results it would appear that the basic intake rate selected for use in the test was too high (1.0 inches and 0.8 inches per hour). This along with too small an estimated available moisture storage amount could compound the situation, resulting in too large a stream size per border irrigated.

Results of moisture monitoring confirm the fact that the area in general was underirrigated. Although Figure 18 indicates there was overirrigation, neutron meter moisture readings do not indicate any overirrigation as the general moisture increase of the soil profile was 0.75 inches. There is no apparent reason for the indication in Figure 18.

### D. Wetting Profiles

To illustrate the profiling obtained from 1969 tests, Figure 19



has been included. There are some interesting indications of variations caused by slope changes. Uniform slopes Figures 18a, 18c, 18e, 19a, 19c and 19e show generally even wetting by the irrigations applied in 1969. There were some variations and this appeared more pronounced on the flatter 0.3% slope (Figure 19e).

It would appear that soil variations in combination with the slight slope results in more wetting variation. The flatter slope resulted in a greater amount added at the start of the border than occurred on other plots tested. It should be pointed out that this border, Figure 19e, was the longest border and this would also affect the moisture distribution.

Figures 19b and 19d show more variations in the moisture distribution. The first three hundred feet of these borders did not show consistency but in the second (steeper) slope section there was a reduction in amounts added. Bench 3, Border 2 (Figure 19b) would likely appear more like Bench 6, Border 2 (Figure 19d) if an additional instrument reading had been made at Station 4+00. There does not appear to be any known reason for the large amount added at Station 3+25 on this border. Additional tests will confirm or correct this seeming extreme variation in the anticipated wetting pattern.

The slope change (concave) at Station 7+00 in both Figures 19b and 19d showed a definite higher amount of water added to storage. It is also interesting to note the larger amount where the steeper slope changes to the flatter slope (Figure 19d). The soils of this border are coarser than Bench 3, Border 2, however there does not appear to be that great a textural difference to cause such a large moisture amount differential at Stations 7+30.





Readings on tensiometers and moisture blocks indicate some interesting aspects of these instruments. Of interest is the lag time required for moisture to move to the 2nd, 3rd and 4th foot. Moisture in some instances (Figure 20a) required a lag time of four days before it moved from the wetted 1st foot down to the lower 4th foot. This result indicates that although the 1st, 2nd and 3rd foot were basically at field capacity following the irrigation and the normal 24 to 48-hour period, the 4th foot had yet to achieve the field capacity condition following four days. Any sampling done of the full profile prior to or during the four days following irrigation would have included detention storage moisture in the total stored amount, rather than indicating field capacity conditions at all four feet of depth.

Field capacity is reached in the 1-foot zone after two days - following a slight peak after one day indicating detention storage. In the 2nd foot the field capacity is reached and maintained until three days after irrigation. The same general condition occurs in the 3rd foot but gravitational water moving through from above maintain a field capacity plateau for six days after irrigation. The lower layer (4 ft.) finally reacts to the added water four days after irrigation but does not plateau as did the 2nd and 3rd foot.

The plateaus seem to indicate a value of field capacity but, because of only a single year of study, additional readings will be made before making any estimate of field capacity, etc.

Laboratory water holding capacity determinations of the soils from the Bow Island Plots, based on readings made by moisture blocks and tensiometers, were in agreement at some sites. The 1969 readings



were not made to evaluate this feature but a slight modification could be made in 1970 to determine if agreement could be achieved.

In Figure 20b the large moisture fluctuation in the 1st foot is not evident in the 2nd, 3rd and 4th foot of depth. This illustrates the large detention storage amount which moves by gravitational pull to lower depths after approximately 24 hours.

To illustrate an interesting variation possible as a result of soils Figure 21a was included. The full profile of Figures 21a and 21b had a very pronounced increase in the soil moisture amounts. Figure 21a was not as pronounced as Figure 21b at the 3rd foot of depth. It is interesting to note that in Figure 21a the soils are LS, S, CL whereas in Figure 21b they are S, S, S, SL. This would illustrate the effects of permeability and water holding capacity of soils on water movement and wetting patterns.

This plateau effect as noted in previous figures is again evident in Figure 22a. The delay in time of movement to the lower depths is evident. The lack of use by either plants or capillarity is well illustrated by the straight line plots at the 3rd and 4th foot of depth of Figures 22a and 22b. Of interest is the general horizontal nature of the curves at all depths due mainly to the rains in the latter part of June and the first week of July which tended to compensate for consumptive use amounts.

#### E. Structure Analysis

A visual evaluation of the Butyl rubber water conveyance tube, was made and after one year there is evidence of some hole damage in the material. The tube was laid in the bottom of the original earth





conveyance ditch. With the flow of water through the tube, tightening of the rubber material occurs. It is believed that it is this stress on the rubber material that in most cases has caused the hole damage. At present there would be an average of about one hole per every 200 feet. Patching of the rubber material is rather a simple operation and will have to be carried out before further use of the rubber conveyance tube can be made.

Visual inspection of the concrete ditch revealed no cracking or heaving or other damage has yet occurred since construction in 1967.

All other structures (check structures and turnouts) proved to do a satisfactory job, although some leakage did result when the checks were completely closed and a complete seal was not made. This leakage was stopped with the aid of a canvas dam when all water was to be held back by the check.

#### CONCLUSIONS

1. Results of single ring infiltrometer tests showed no correlation between cut and fill and basic infiltration rates. There was no modification of this rate with various combinations of cut or fill and soil textures.
2. Although there was some indication of yield reduction due to high surface lime (10% HCL tests) this was not substantiated by laboratory tests indicating high lime (lowest pH value 7.5 at 0 - 6").
3. There was some indication of poor yields on coarse textured soils areas. This was not consistent at all of these soils areas and



the validity of this indication will have to be checked with further tests.

4. The border irrigation stream sizes were based on ring infiltrometer results. The underirrigation that occurred along with a uniform wetting pattern on borders with uniform downfield slope showed that the basic infiltration value used was too high. The value of 0.65 inches per hour would be more suitable than 0.8 and 1.0 inches per hour used in 1969.
5. Initial indications are that downfield slope changes affect the wetting profiles. The major affect being noted in the slope changes from steeper to flatter (concave).
6. Profiles that are sampled to four feet and within four days following an irrigation will still have detention storage. Sampling to determine field capacity after two days can have gravitational water still moving down at lower depths (3 and 4 feet) and therefore the total for the root zone would include water not associated with that defined by field capacity. Taking the difference between samples taken after an irrigation (within two days) and before the next irrigation, can include not only crop use but also some water lost to deep percolation.
7. Some field readings of field capacity confirmed field capacity readings determined by laboratory analysis. This was not consistent at all stations.
8. Butyl lay flat tubing appeared physically suitable for use in transporting water from the head ditch to the secondary supply ditch. There was some damage but the repairs were very minor





and could be easily handled in a farm operation. The ditch that the tubing lay in had slight slope but it was still enough to have erosion without the tubing. There is no guarantee that the tubing would be as serviceable on steep slopes.

#### RECOMMENDATIONS

1. To evaluate infiltration values, determined by single ring infiltrometers, Finkle and Nir tests should be made on the borders in 1970.
2. Further evaluations of wetting profiles effects from slope changes should be made and results adjusted for soil changes.
3. Individual report of crop moisture use should be prepared.
4. An individual report of border evaluations in 1969 and 1970 should be prepared and checked against the Irrigation Guide recommendations.
5. Further evaluations of crop yields will have to wait for an adequate stand of pasture grass. These evaluations will likely be made in 1971.
6. More intensive readings of soil moisture will provide adequate data for evaluations of field capacity values in situ as compared to laboratory pressure plate equipment determinations.
7. Tests (infiltration and irrigation efficiency) should be made at the 50% soil moisture depletion level to provide better operational recommendations orientated to the Irrigation Guide procedures.



REFERENCES

1. Adeniji, Francis. 1970. A micro-study of the mechanics and distribution of soil erosion under furrow irrigation, Bow Island, Alberta. M.Sc. Thesis, Department of Geography, University of Calgary.
2. Criddle, Wayne D., Sterling Davis, Claude H. Pair, Dell G. Shockley. 1956. Methods for evaluating irrigation systems. Agriculture Handbook No. 82. S.C.S. U.S.D.A.
3. Luebs, R.E., M.J. Brown and A.E. Laag. 1968. Determining water content of different soils by the neutron method. Soil Science, Vol. 106, No. 3. 207-212.
4. Richards, L.A. and L.R. Weaver. 1947. Pressure membrane apparatus - construction and use. Agr. Eng. 28: 451-454.





## APPENDIX



REQUEST FOR ASSISTANCE UNDER THE FEDERAL-PROVINCIAL  
RURAL DEVELOPMENT AGREEMENT 1965-70

PART I - RESEARCH

-----

I. Name of Project:

Irrigation design criteria efficiency and its application to irrigated pasture management on a community grazing system.

II. Objectives and Purpose:

To date, Alberta A.R.D.A. projects have been approved related to the development of irrigated land (A.R.D.A. 9001); development of irrigated grazing reserves (A.R.D.A. 9002, 9005, 9011, 9018, 9019 and 9020); appraisal of land levelling (A.R.D.A. 9015) and the economics of pasture production (A.R.D.A. 9040). All of the aforementioned projects have as a common denominator the conservation and development of the province's soil and water resources, for the production, in whole or in part, of pasture. It is, therefore, proposed that a systematic analysis of irrigation design criteria and irrigated pasture management under a community grazing regime would, wholly or in part, complement the projects mentioned earlier.

Phase I of the project consists of irrigation design criteria efficiency analysis of land levelling design criteria as related to erosion control and crop production. Observations of the irrigated areas indicate that research in water control and irrigation efficiency on the farm is needed to evaluate existing design criteria and to gather data more applicable to the area which would eliminate some of the interpolation of data being used from other areas.

Phase II of the project, irrigated pasture management on





an intensive community grazing system, is the study of an inherent problem of irrigated grazing reserve management which will also become a problem of private large-scale irrigated pasture management. Many of the problems involved stem from scale of operations and the diversity of livestock herds; consequently, these are problems not encountered on research plots. It is, therefore, reasoned that this research could be more conveniently carried out in conjunction with the irrigated grazing reserve management.

Phase III of the project, the economics of irrigated grazing reserves, will be of considerable value to the policy makers in the Lands Division of the Department of Lands and Forests.

The specific objectives of this research proposal are as follows:

- 1) To evaluate land levelling design criteria for light soils at varying degrees of slope and to determine irrigation efficiency using the furrow, corrugation and border dyke methods of irrigation under bare and cropped conditions.
- 2) To study the practical application of semi-automated and automated forms of concrete-lined and buried gravity distribution systems for irrigated areas of Southern Alberta.
- 3) To determine the effects of herd population under constant carrying capacity but varying stocking rates through varying periods of the grazing season upon:
  - (i) infiltration and permeability rate of the soil;
  - (ii) fertilizer response;
  - (iii) sward species composition;
  - (iv) forage nutritive composition;
  - (v) daily rate of animal gain;



- (vi) parasite population;
  - (vii) animal behavioral patterns.
- 4) To determine the economic feasibility of producing beef on irrigated pasture under community grazing practices;
- (i) taking into consideration the farmers cost of feeding cows during the non-grazing season;
  - (ii) taking into consideration the farmers costs of purchasing feeder cattle to put on irrigated forage;
  - (iii) taking into consideration the returns required to repay capital, operation, maintenance and replacement.
- 5) To evaluate the benefits accruing to the public from the operation of an irrigated grazing reserve.

### III. Benefits:

The benefits will accrue to the irrigated agricultural economy of Southern Alberta through the development of soil and water conserving design criteria, to the public administrative agencies responsible for the development and operation of irrigated grazing reserves and to the farming public utilizing these facilities.

### IV. Project Description:

#### 1) Location and Type

This project will be carried out on lands which upon completion of the studies will be transferred to the Bow Island Grazing Reserve.

It will consist of the purchase of 320 acres of submarginal land; the land levelling to specific design



criteria; the installation of various concrete and buried pipe water conveyance structures in conjunction with automated irrigation systems; the seeding to row crop, grain and pasture and the irrigation of the same. In addition, the fields will be fenced in order that the pasture can be grazed. Holding pens will be constructed to inspect and weigh cattle, personnel will be hired to carry out the measurements and carry out the field work. Various meteorological instruments will be purchased in order that irrigation requirements can be more closely determined.

These tests will be carried out on the NW 31-11-10-W4 and SW 6-12-10-W4.

2) Description of Work

<u>Description</u>	<u>Proposed</u>	
	<u>April 1/65 - March 31/70</u>	
	<u>Units</u>	<u>Estimated Cost</u>
(a) Provincial staff -		
(i) field technicians	36 months	\$ 14,400
(ii) laboratory technicians	6 months	2,100
(iii) field laborers	36 months	10,000
(b) Travelling expenses		10,000
(c) Land purchases -		
(i) patented	320 acres	750
(ii) Crown	Nil	
(d) Fence construction -		
(i) fencing	6 miles	3,600
(ii) holding pens	2	200
(e) Irrigation development -		
(i) land levelling	140 acres	28,000
(ii) irrigation works	140 acres	22,000
(iii) drainage works	140 acres	3,000
(f) Cultivation & seeding )		
(i) irrigated forage )	140 acres	4,200
(g) Stockwater	7 dugouts	2,000





(h) Instruments & equipment -

15	Tensiometers 1 ft. (Manometer type)	\$	300.00	
15	Tensiometers 2 ft. (Manometer type)		315.00	
15	Tensiometers 3 ft. (Manometer type)		330.00	
15	Tensiometers 4 ft. (Manometer type)		360.00	
15	Tensiometers 5 ft. (Manometer type)		390.00	
15	Tensiometers 6 ft. (Manometer type)		420.00	
1	Anemometer (Tower type - including recorder)		500.00	
12	Max.-Min. Soil thermometers		1,140.00	
1	Sling psychrometer		15.00	
1	Evaporation pan		250.00	
1	Rain gauge		10.00	
1	King tube, hammer, sample cans, etc.		70.00	
1	Core Sampler and sample cylinders		210.00	
2	Max.-Min. Thermometers and screen		60.00	
1	Auger and moisture tins		70.00	
2	Parshall flumes concrete		120.00	
6	Parshall flumes wood		150.00	
1	Tensiometer insertion tool		10.00	
15	8-ft. Neutron meter access tubes		240.00	
5	Fiberglass moisture block @ \$8.00		40.00	
				5,000

(i) Printing & publishing reports

500

Total:

\$105,750

3) Timing and Phasing

See cost table below.

V. Cost and Revenue:

1) Cost

The land, which cost approximately \$750.00 has been purchased as part of Alberta's Land Assembly Program, A.R.D.A. 28023, in October 1965. The remainder of the expenditures as per A.R.D.A. 1965-70, Part I, section 13 (1); 100% shareable.



<u>Type of Expenditure</u>	<u>Total</u>	<u>Provincial</u>	<u>Shareable</u>	<u>Federal Contribution</u>
(a) Provincial staff:				
1967-68	\$ 8,833	\$ 4,417	\$ 8,833	\$ 4,416
1968-69	8,833	4,417	8,833	4,416
1969-70	8,834	4,417	8,834	4,417
(b) Travelling expenses:				
1967-68	3,333	1,666	3,333	1,667
1968-69	3,333	1,666	3,333	1,667
1969-70	3,334	1,667	3,334	1,667
(c) Land development:				
1966-67: Fence construction	1,800	900	1,800	900
Irrigation development	28,000	14,000	28,000	14,000
Stockwater	2,000	1,000	2,000	1,000
1967-68: Fence construction	2,000	1,000	2,000	1,000
Irrigation development	25,000	12,500	25,000	12,500
Cultivation & seeding	4,200	2,100	4,200	2,100
(d) Instruments & equipment:				
1967-68	5,000	2,500	5,000	2,500
(e) Printing & publishing reports:				
1969-70	500	250	500	250
Total:	<u>\$105,000</u>	<u>\$52,500</u>	<u>\$105,000</u>	<u>\$52,500</u>

	<u>Total</u>	<u>Provincial</u>	<u>Shareable</u>	<u>Federal Contribution</u>
1966-67	\$ 31,800	\$15,900	\$ 31,800	\$15,900
1967-68	48,366	24,183	48,366	24,183
1968-69	12,166	6,083	12,166	6,083
1969-70	<u>12,668</u>	<u>6,334</u>	<u>12,668</u>	<u>6,334</u>
Total:	<u>\$105,000</u>	<u>\$52,500</u>	<u>\$105,000</u>	<u>\$52,500</u>





2) Revenue

It is not anticipated that any revenue will be generated by this project during the period 1966-70. After the completion of the research project the capital works will be transferred to the Bow Island Grazing Reserve project (A.R.D.A. 9005) for inclusion. Revenues derived after that date will be used for operation, maintenance and replacement.

VI. Organization:

The Lands and Forests Conservation and Utilization Chairman of the Division of Program Development, Alberta Department of Agriculture will be responsible for the project. The Land Development Branch and Agrohydrology Branch of the Water Resources Division, Alberta Department of Agriculture will be working in co-operation with the Soil Section, Forage Crops Section and Animal Science Section of the Lethbridge Research Station, Canada Department of Agriculture; the Grazing Section of the Land Division, Alberta Department of Lands and Forests; the Production Research Section; Farm Economics Division, Alberta Department of Agriculture; and various other provincial Department of Agriculture agencies whose area of work is related to this research.

NOTE: See Figure 7 for study area layout.



## FIGURES



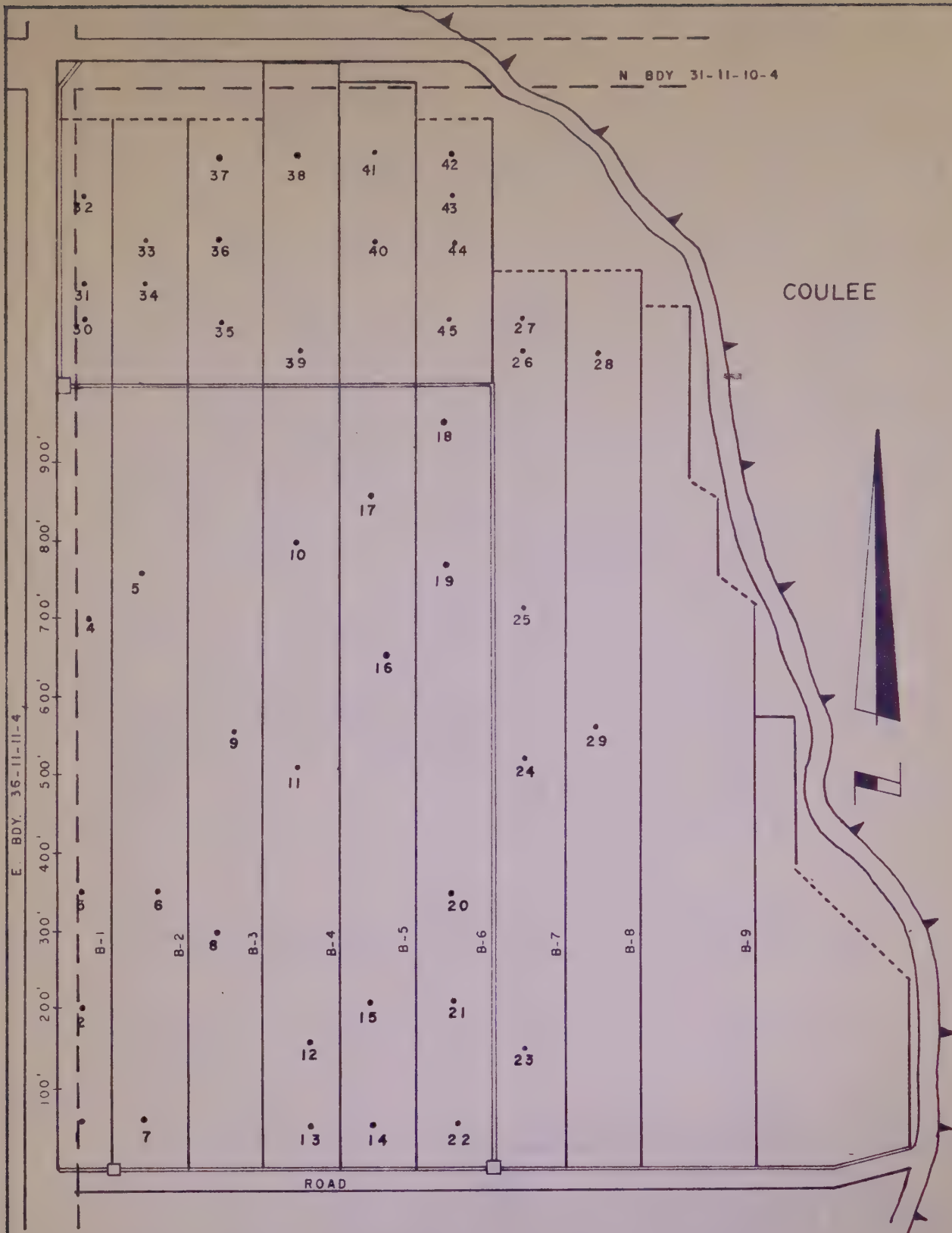


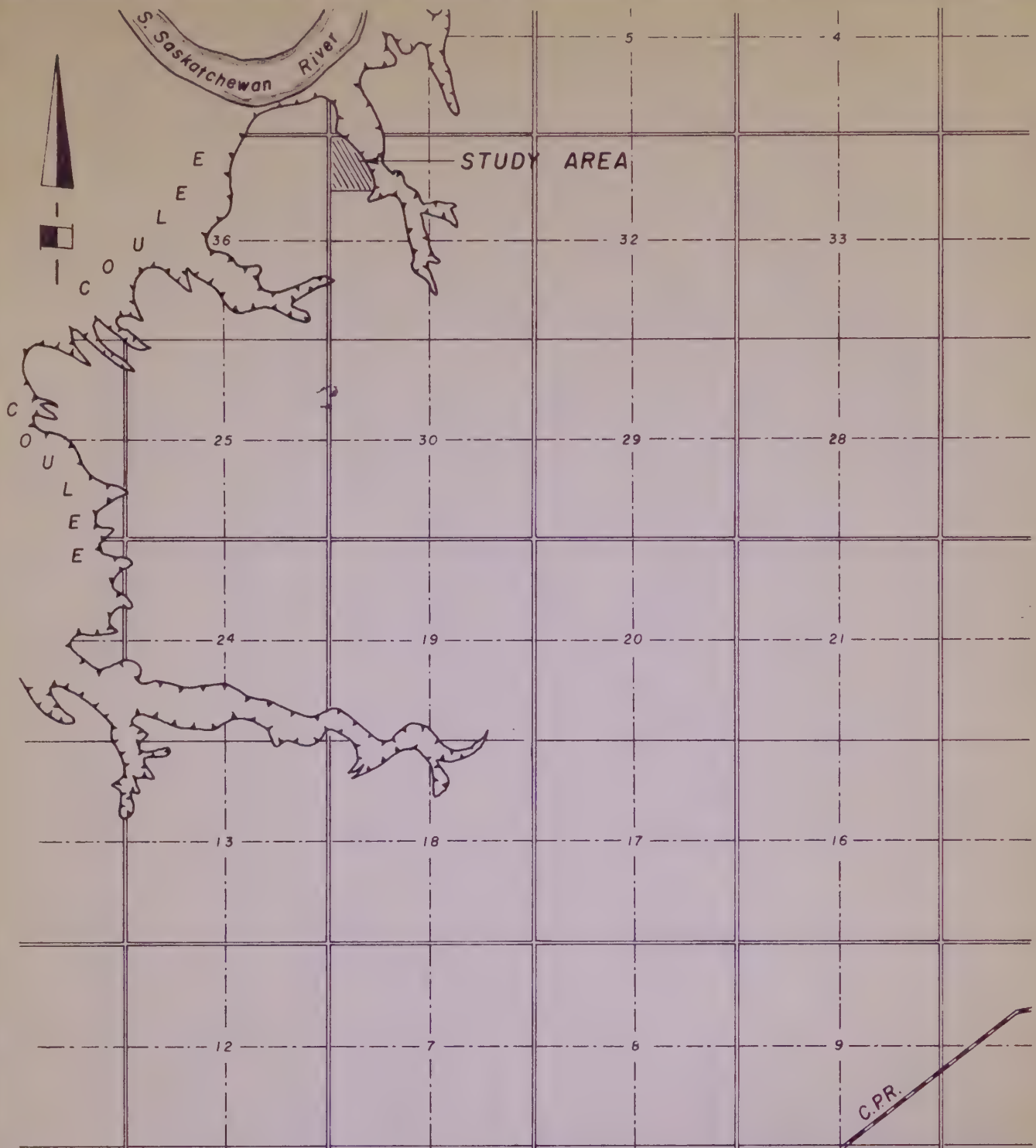


FIGURE 1

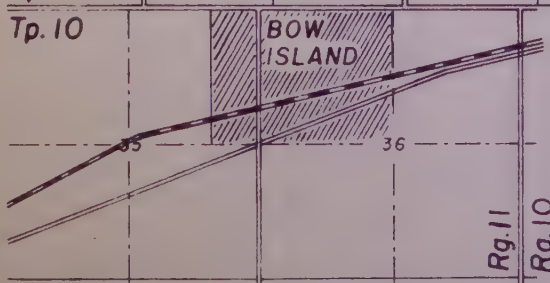
 ALBERTA DEPARTMENT OF AGRICULTURE WATER RESOURCES DIVISION AGROHYDROLOGY BRANCH				<b>BOW ISLAND TEST PLOTS</b> <b>SAMPLING LOCATIONS</b> <b>FOR FERTILIZER REQUIREMENTS</b> 1968	
Submitted by	Designed by	Date	Date MAY 15, 1970		
Date	Drawn by T. ANDROSOFF	Checked by	Sheet of		
Approved by <i>Glen L. Steet</i>			Scale: 1" = 200'		
Date <i>May 28, 1970</i>			File No. 08-M-1-K-22		







Tp. 11  
Tp. 10



GOVERNMENT OF ALBERTA  
DEPARTMENT OF AGRICULTURE  
WATER RESOURCES DIVISION  
AGROHYDROLOGY BRANCH



# BOW ISLAND PLOTS GENERAL LOCATION PLAN FIGURE 2

SCALE - NOT TO SCALE

DATE - APRIL 10 1970

INVESTIGATED BY.....  
SUBMITTED BY.....  
APPROVED BY *Glen L. Steed*  
DATE *May 28, 1970.*

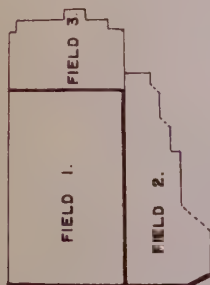
SURVEYED BY.....  
DESIGNED BY.....  
DRAWN BY *N. ALEXANDER*  
LETHBRIDGE DRAFTING SERVICE  
PLAN No. C8-M-1-B-3







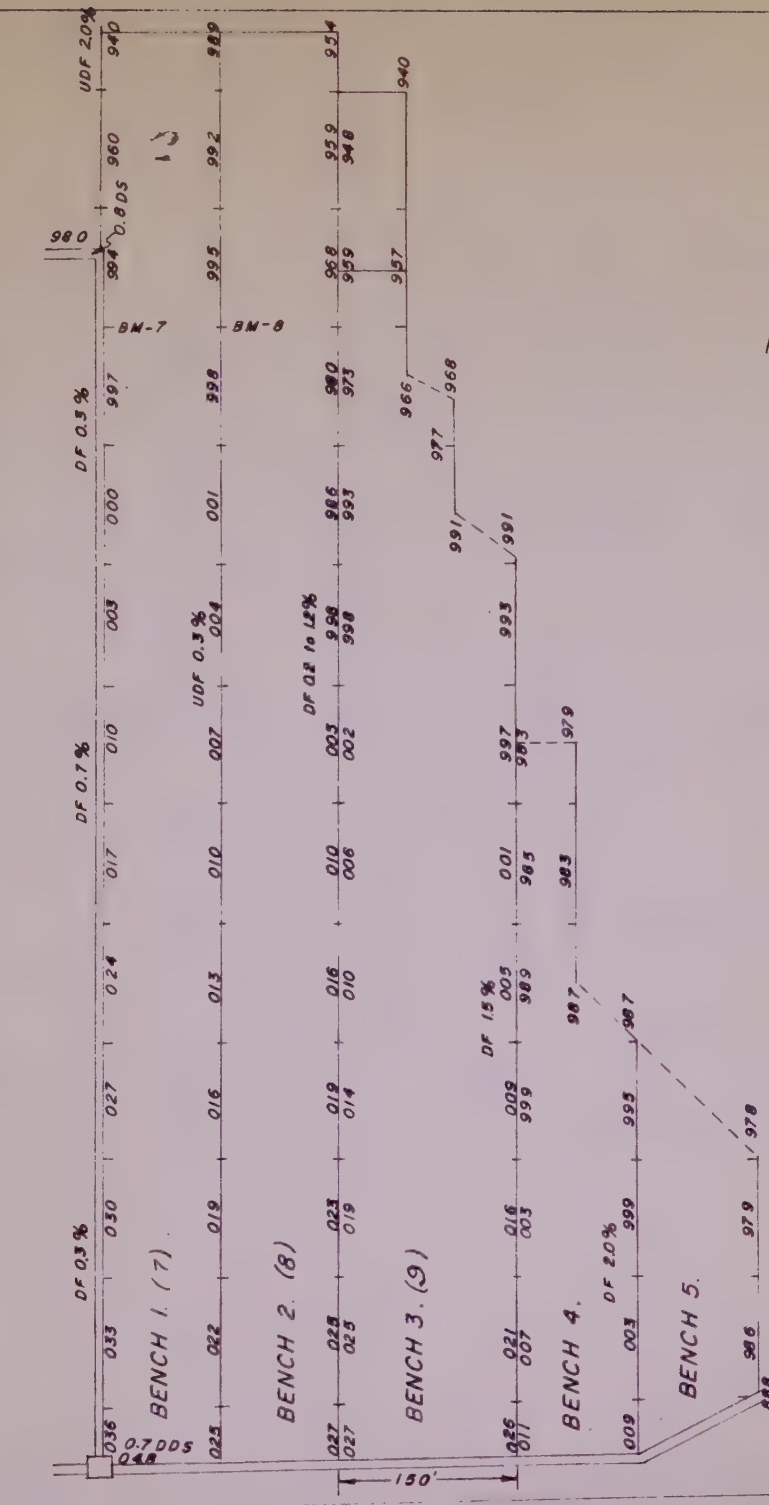




KEY PLAN

NOTE:

BM-BENCH MARK  
 DF-DOWN FIELD SLOPE  
 UBF-UNIFORM DOWN FIELD  
 CDF-CONCAVE DOWN FIELD  
 CXDF-CONVEX DOWN FIELD  
 DS-DROP STRUCTURE  
 DDS-DROP DIVERSION STRUCTURE



FIELD 2.

FIGURE 4



GOVERNMENT OF ALBERTA  
 DEPARTMENT OF AGRICULTURE  
 WATER RESOURCES DIVISION  
 AGROHYDROLOGY BRANCH



BOW ISLAND TEST PLOTS

NW. 31-11-10-4

SCALE - 0.6" = 100'

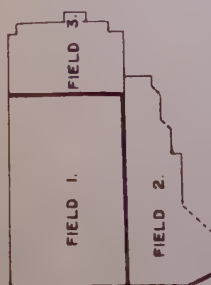
DATE - MAY/70





NOTE.

BM - BENCH MARK  
 DF - DOWN FIELDSLOPE  
 UDF - UNIFORM DOWN FIELD  
 CDF - CONCAVE DOWN FIELD  
 CXDF - CONVEX DOWN FIELD  
 DS - DROP STRUCTURE  
 DDS - DROP DIVERSION STRUCTURE



KEY PLAN

FIELD 3.

FIGURE 5



GOVERNMENT OF ALBERTA  
 DEPARTMENT OF AGRICULTURE  
 WATER RESOURCES DIVISION  
 AGROHYDROLOGY BRANCH



BOW ISLAND TEST PLOTS  
 NW 31-11-10-4

SCALE - 1" = 100'

DATE - MAY/70





DISTANCE DOWN BENCH (FT.)

200 400 600 800 1000

NOTE

U.D.F. - UNIFORM DOWN FIELD

V.D.F. - VARIABLE DOWN FIELD

D.F. - DOWN FIELD

BENCH 1

BENCH 2

BENCH 3

BENCH 4

BENCH 5

BENCH 6

BENCH 7

BENCH 8

BENCH 9

FIGURE 6



ALBERTA DEPARTMENT OF AGRICULTURE  
WATER RESOURCES DIVISION  
AGROHYDROLOGY BRANCH



BOW ISLAND TEST PLOTS

PROFILES OF BENCH SLOPES

Submitted by \_\_\_\_\_  
Date \_\_\_\_\_  
Approved by *Glen L. Stead*  
Date *May 20, 1970*

Designed by \_\_\_\_\_  
Drawn by T. ANDROSOFF  
Checked by *[Signature]*

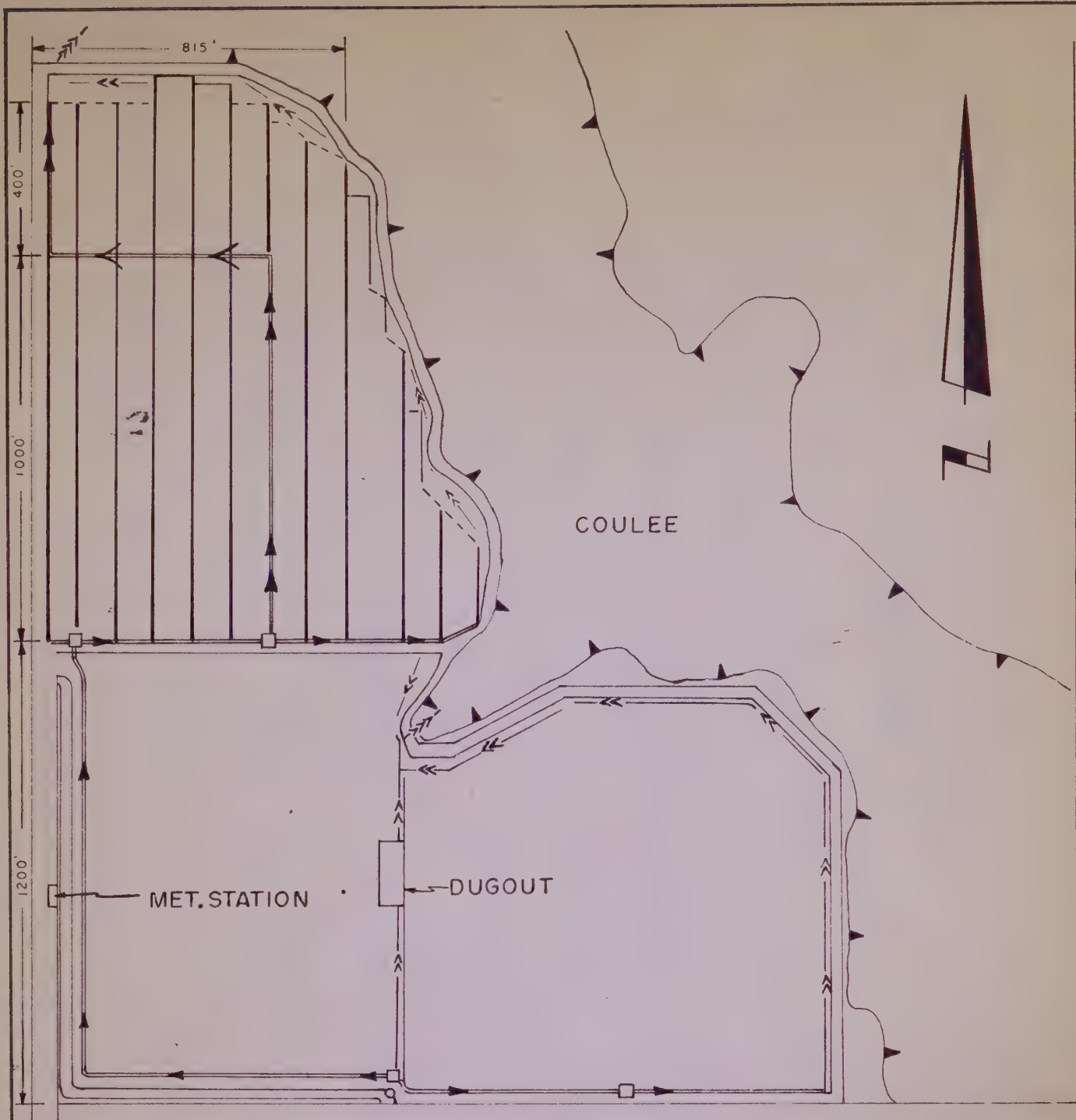
Date APRIL 21, 1970

Scale: VERTICAL: 1"=10'

File No. CB-M-1-K-26







### LEGEND

- >>— Drain
- >>>— Culvert drop to bottom of coulee
- ==>> Concrete ditch
- ==>>> Butyl conveyance pipe
- ==>> Earth ditch
- ==>>> Turnout from lateral to concrete ditch

FIGURE 7



ALBERTA DEPARTMENT OF AGRICULTURE  
WATER RESOURCES DIVISION  
AGROHYDROLOGY BRANCH



### BOW ISLAND TEST PLOTS GENERAL LAYOUT

Submitted by

Date:

Approved by *John L. Sted*

Date: *May 20, 1970*

Designed by

Drawn by:

Checked by

*T. ANDROSOFF*

Date: APRIL 16, 1970

Sheet of

Scale: 1" = 400'

File No. C8-M-1-K-27



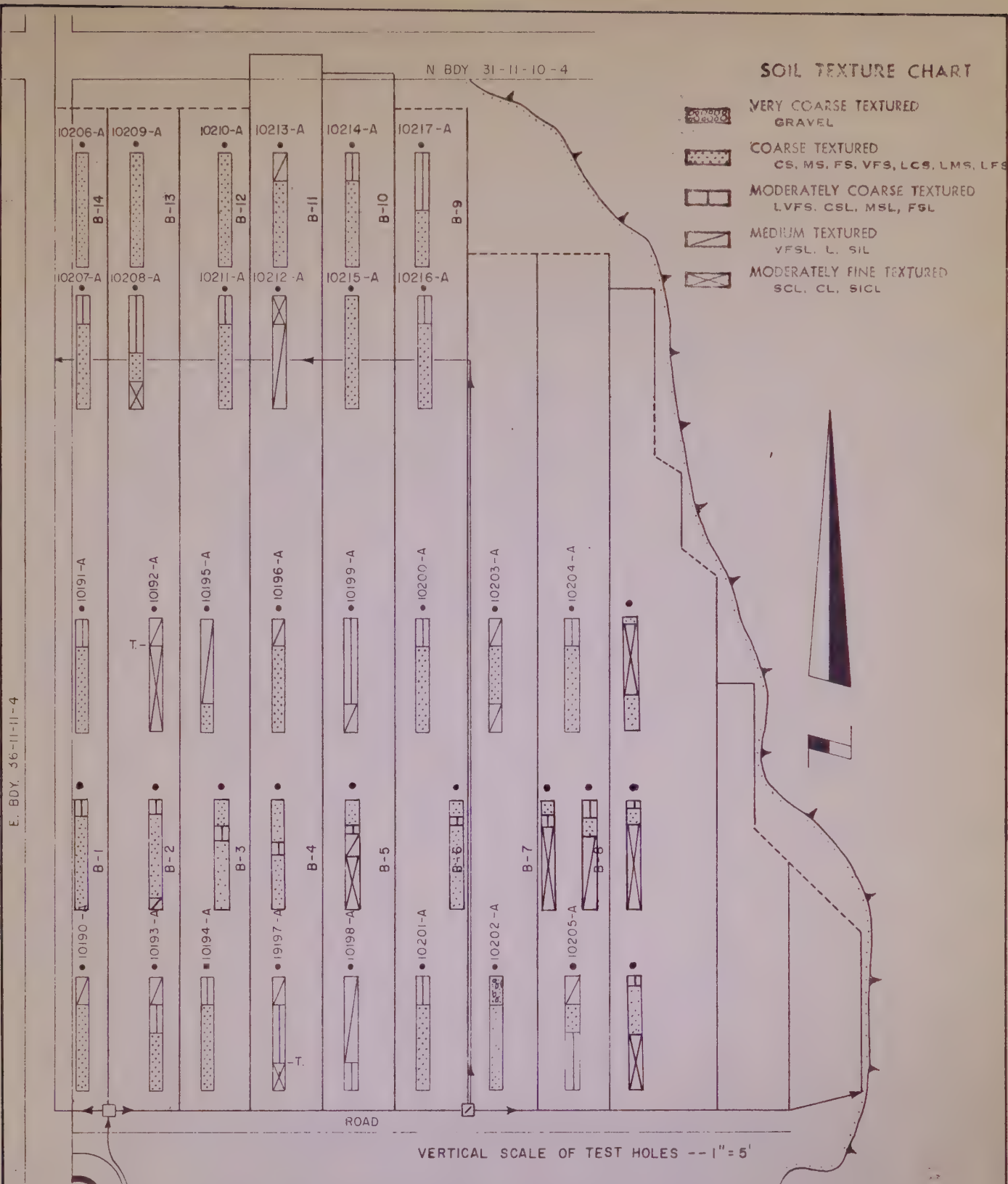




FIGURE 8

 <b>ALBERTA DEPARTMENT OF AGRICULTURE</b> <b>WATER RESOURCES DIVISION</b> <b>AGROHYDROLOGY BRANCH</b>				<b>BOW ISLAND TEST PLOTS</b> <b>NW-31-11-10-4</b> <b>SOIL LOGS</b>	
Submitted by _____		Designed by _____		Date <b>APRIL 22, 1970</b>	
Date _____		Drawn by <b>T. ANDROSQFF</b>		Sheet _____ of _____	
Approved by <i>Steve B. Stead</i>		Checked by <i>[Signature]</i>		Scale: 1" = 200'	
Date <b>May 28, 1970</b>				File No. <b>C8-M-1-K-28</b>	





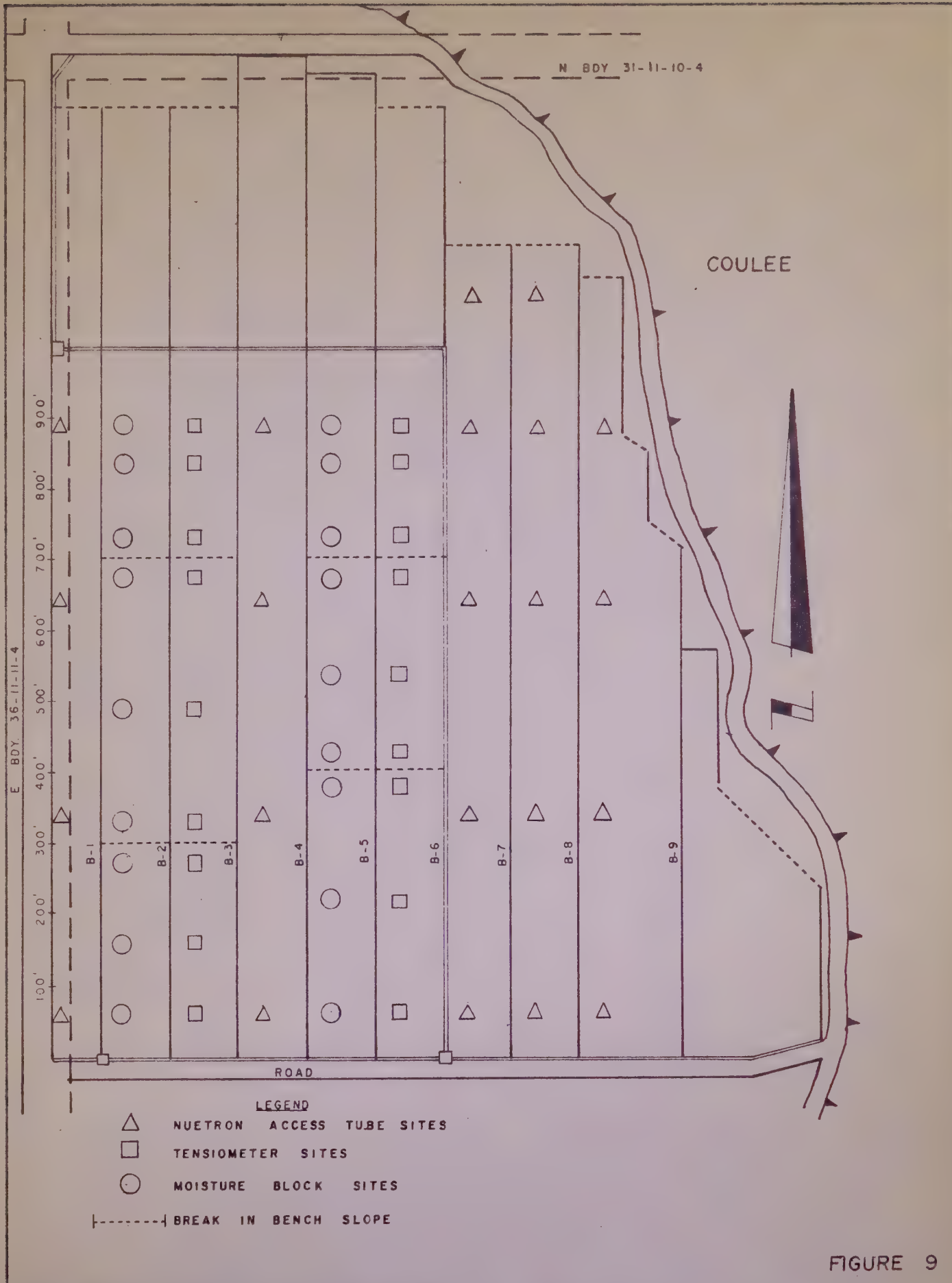



FIGURE 9

 <b>ALBERTA DEPARTMENT OF AGRICULTURE</b> <b>WATER RESOURCES DIVISION</b> AGROHYDROLOGY BRANCH		<b>BOW ISLAND TEST PLOTS</b> SOIL MOISTURE MONITORING LOCATIONS	
Submitted by _____ Date _____ Approved by <i>Glen L. Stebb</i> Date <i>May 23, 1970</i>	Designed by _____ Drawn by <b>T. ANDROSOFF</b> Checked by <i>[Signature]</i>	Date <b>APRIL 21, 1970</b>	Sheet _____ of _____
Scale: 1" = 200'		File No. C8-M-1-K-29	



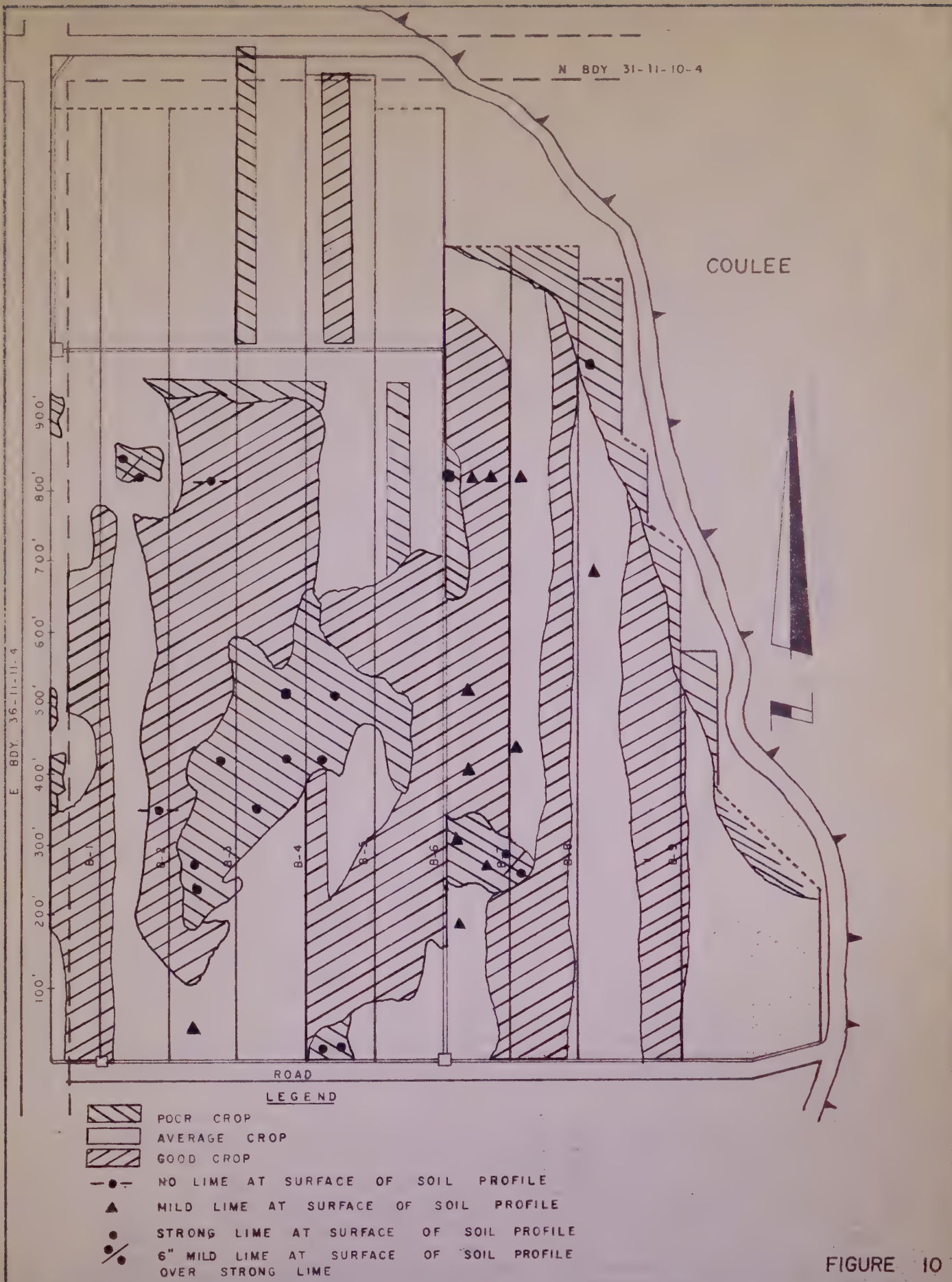


FIGURE 10

<p>ALBERTA DEPARTMENT OF AGRICULTURE WATER RESOURCES DIVISION AGROHYDROLOGY BRANCH</p>		<p><b>BOW ISLAND TEST PLOTS</b> 1969 OAT CROP GROWTH AREAS and LIME INDICATIONS IN SURFACE SOIL</p>	
Submitted by	Designed by	Date	Sheet of
Date	Drawn by: T. ANDROSOFF	APRIL 20, 1970	
Approved by: <i>Alan L. Stut</i>	Checked by: <i>RP</i>	Scale: 1" = 200'	File No. C8-M-1-K-30
Date: May 28, 1970			





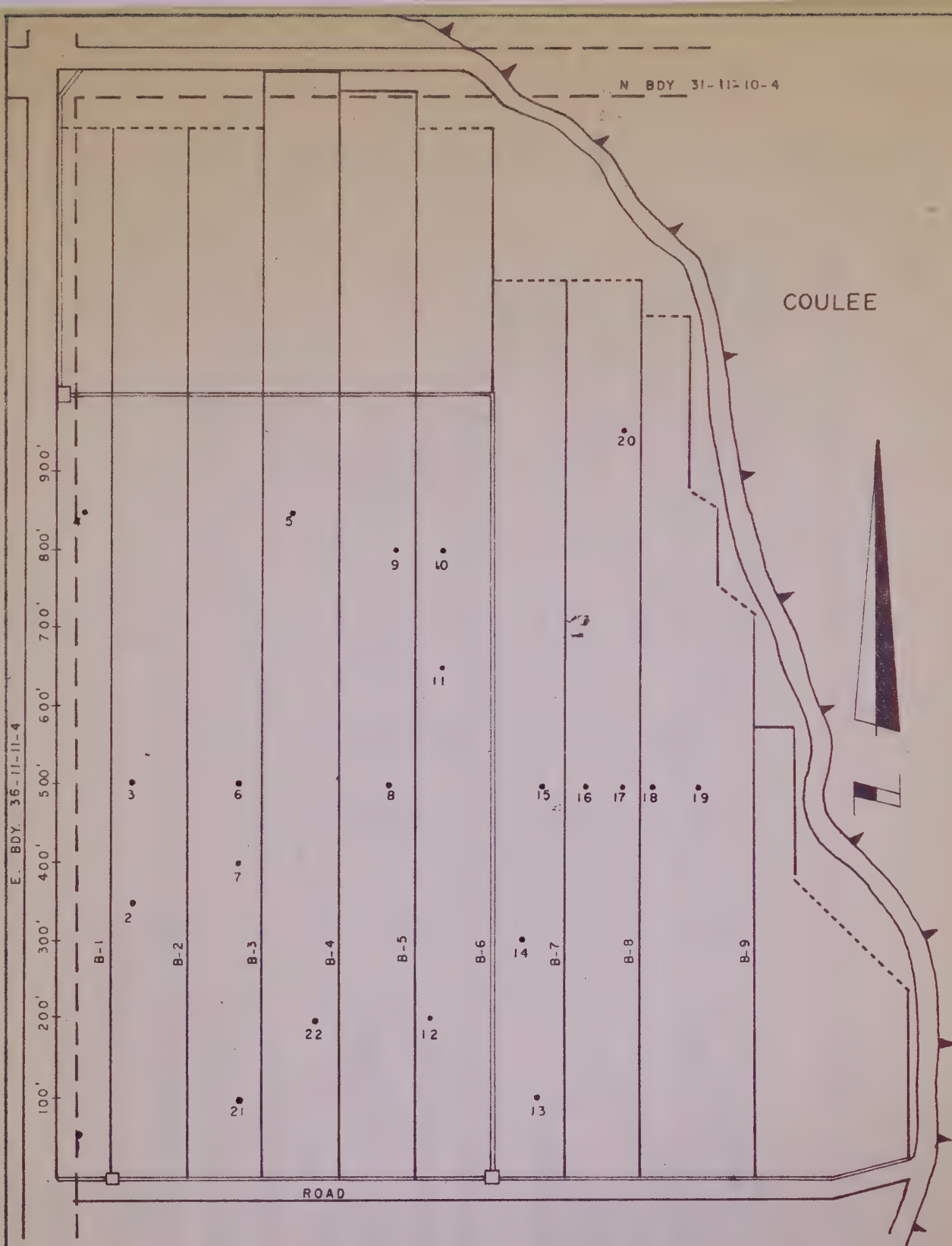


FIGURE II



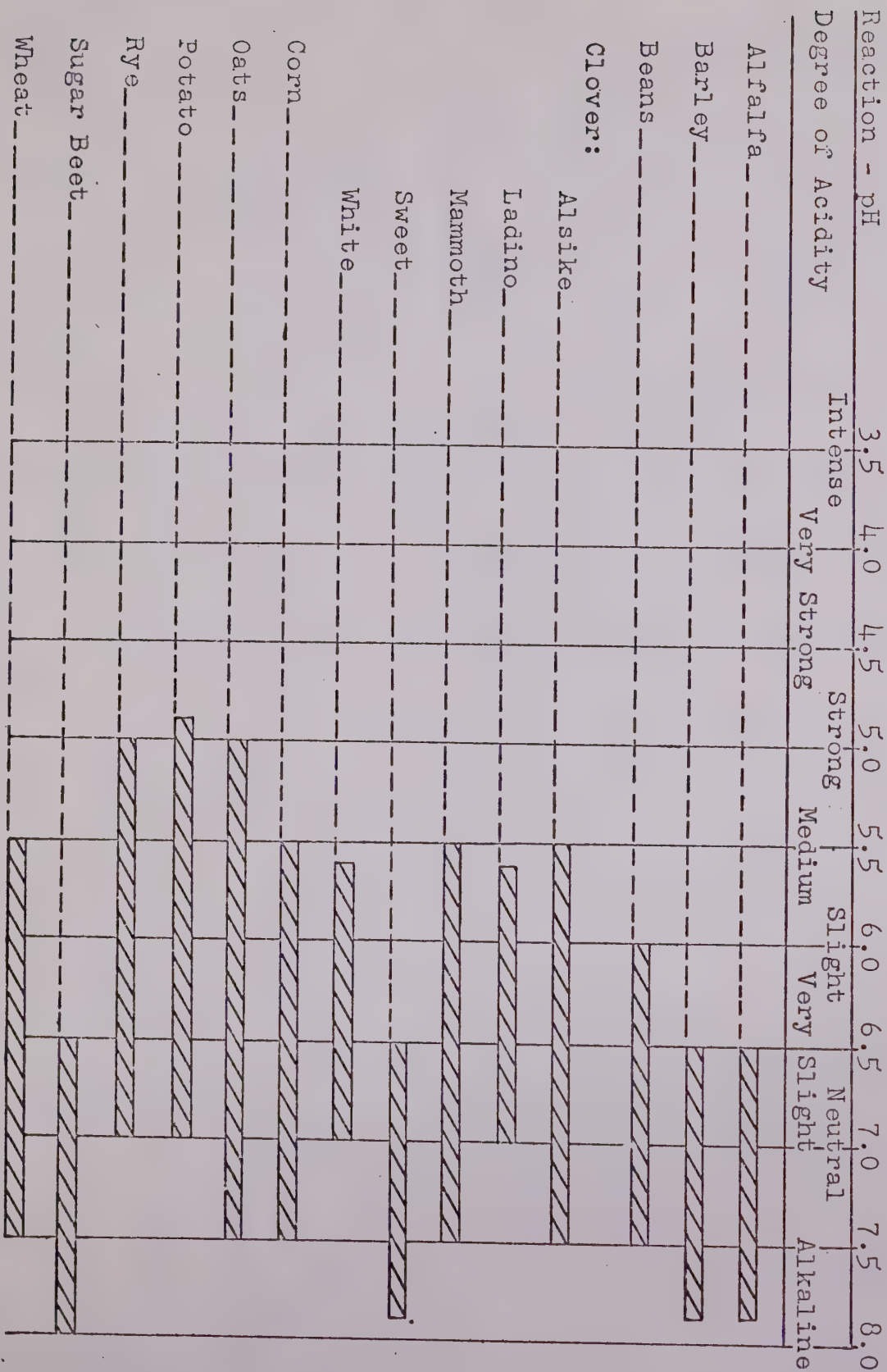
 <b>ALBERTA DEPARTMENT OF AGRICULTURE</b> <b>WATER RESOURCES DIVISION</b> AGROHYDROLOGY BRANCH		 <b>BOW ISLAND TEST PLOTS</b> 1969 SOIL PHYSICS SAMPLING SITES	
Submitted by	Designed by	Date	Sheet of
Date	Drawn by T. ANDRUSOFF	APRIL 21, 1970	
Approved by <i>Glen L. Stett</i>	Checked by <i>[Signature]</i>	Scale: 1" = 200'	File No. C8-M-1-K-31
Date May 28, 1970			





FIG. 12

The Relative Tolerance of Selected Field Crops to Soil Acidity





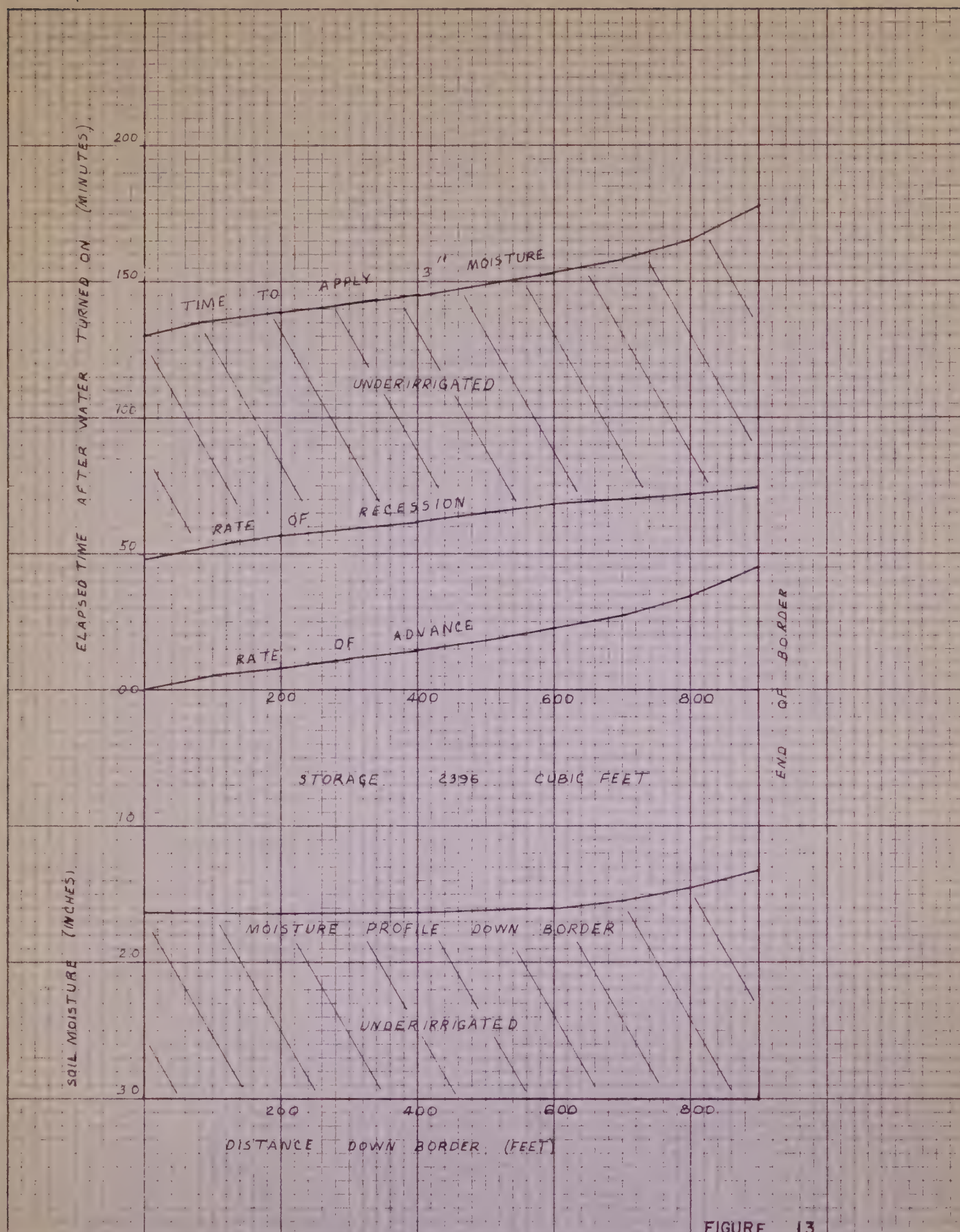


FIGURE 13

BOW ISLAND PLOTS  
 BORDER EVALUATION  
 BENCH 1 BORDER 1  
 JULY 10/69





ELAPSED TIME AFTER WATER TURNED ON (MINUTES)

100

80

60

40

20

0.0

SOIL MOISTURE (INCHES)

2.0

3.0

TIME TO APPLY  
RATE OF RECESSION  
3" MOISTURE  
UNDERIRRIGATED

RATE OF ADVANCE

STORAGE 49.9 CUBIC FEET

MOISTURE PROFILE DOWN BORDER  
UNDERIRRIGATED

DISTANCE DOWN BORDER (FEET)

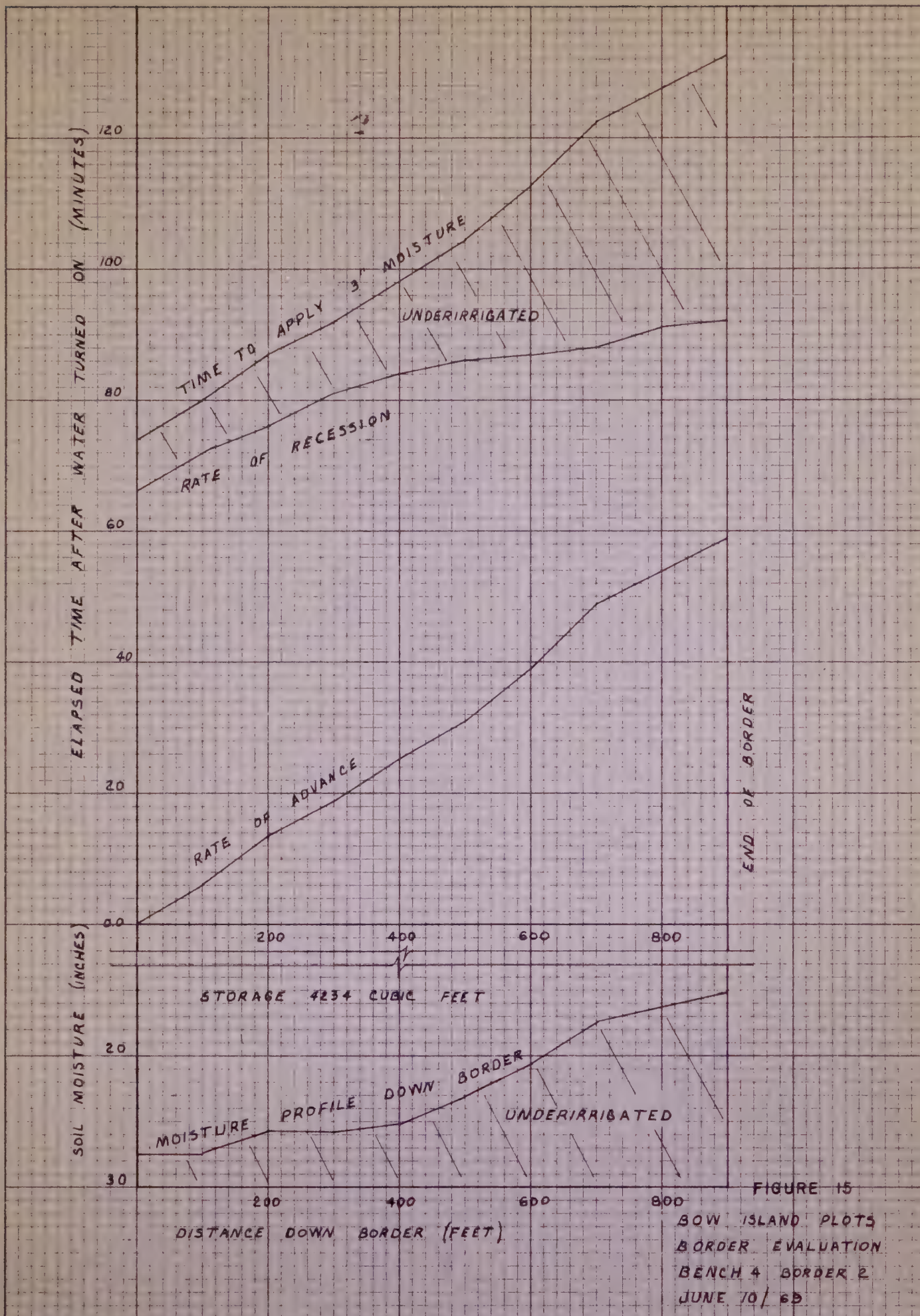
END OF BORDER

FIGURE 14  
BOW ISLAND PLOTS  
BORDER EVALUATION  
BENCH 3 BORDER 2  
JUNE 10/69

KENNEL & EGGERS CO.











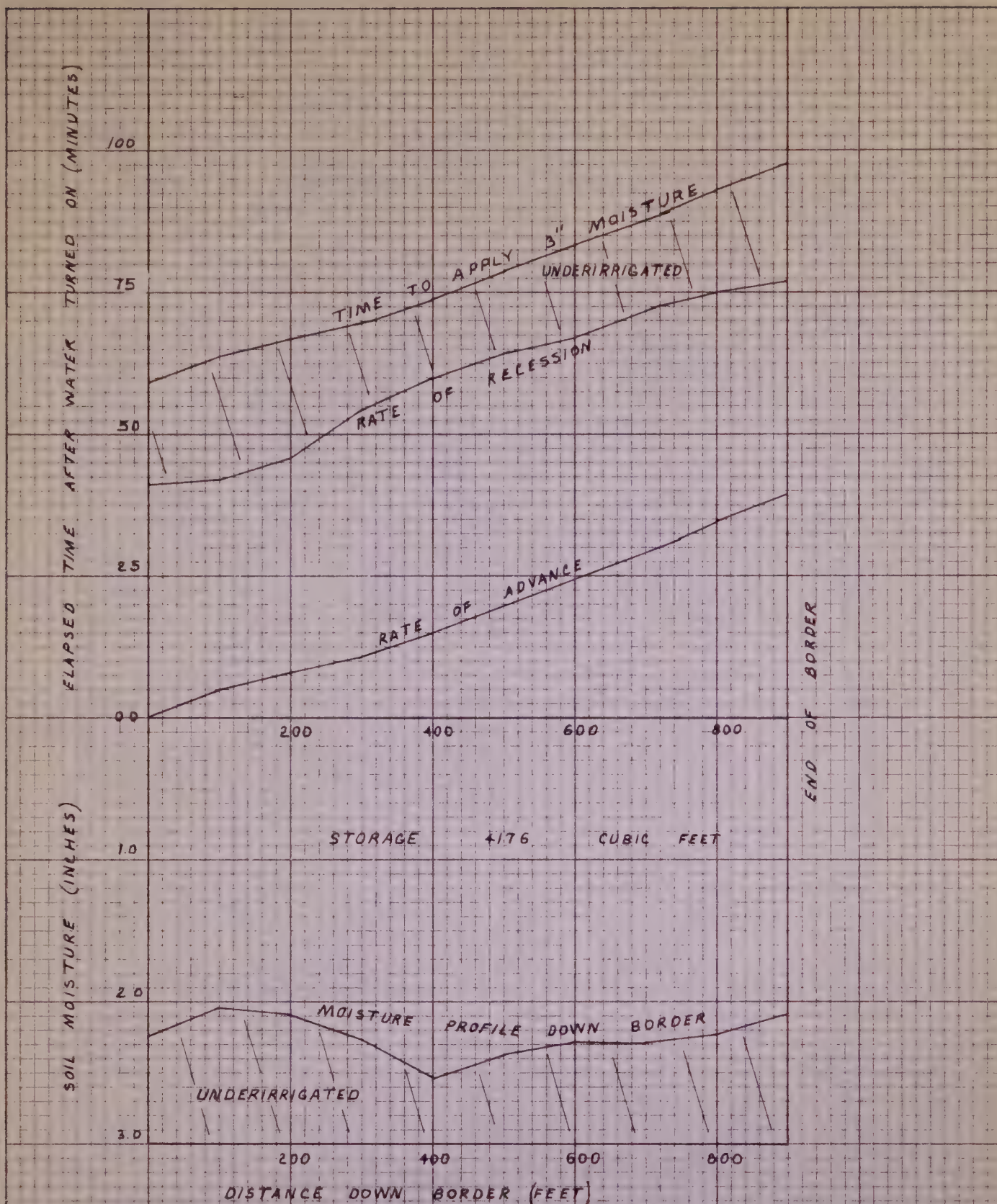


FIGURE 16

BOW ISLAND PLOTS  
 BORDER EVALUATION  
 BENCH 5 BORDER 2  
 JUNE 11/69





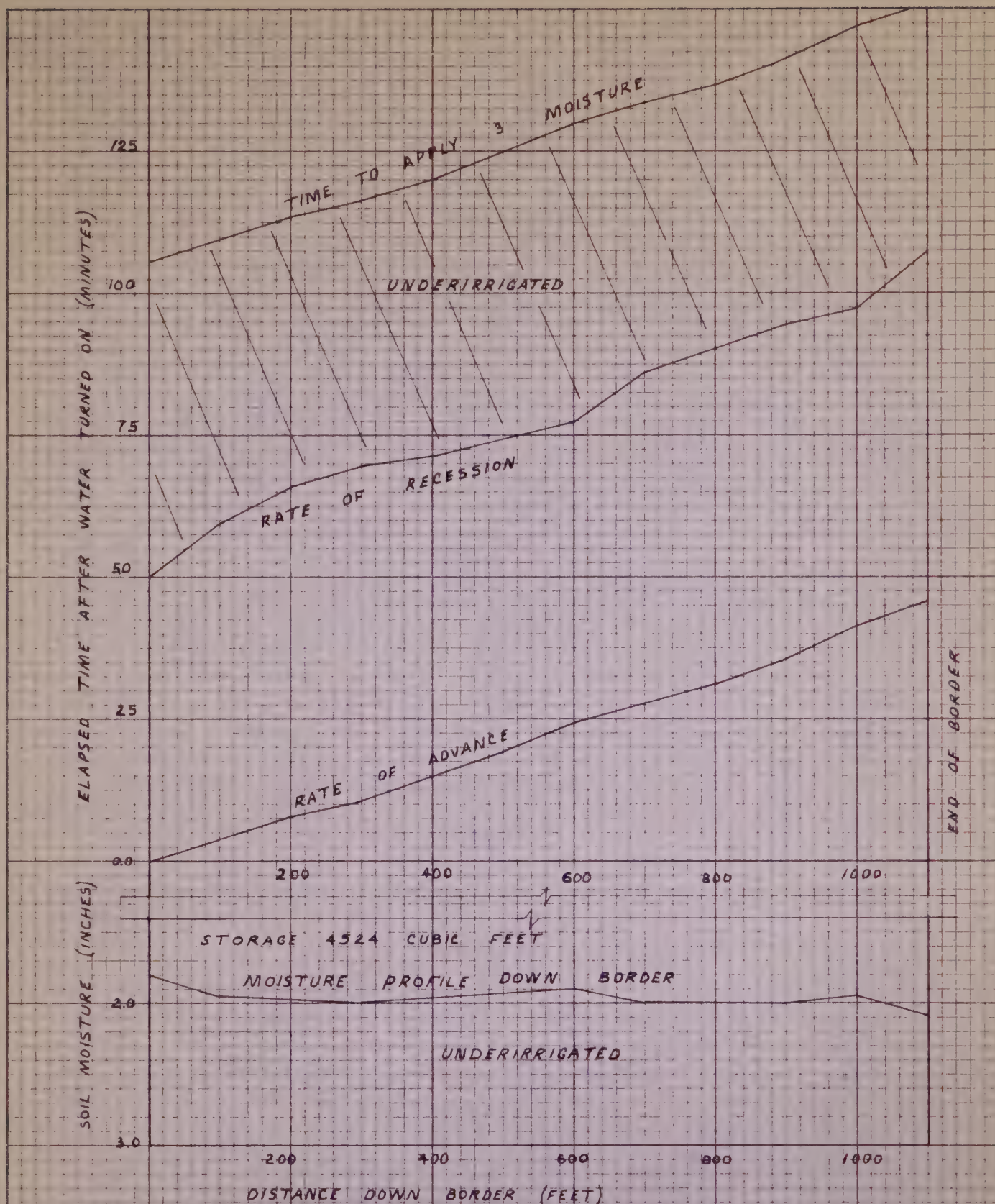


FIGURE 17  
BOW ISLAND PLOTS  
BORDER EVALUATION  
BENCH 7 BORDER 2  
JUNE 12/69





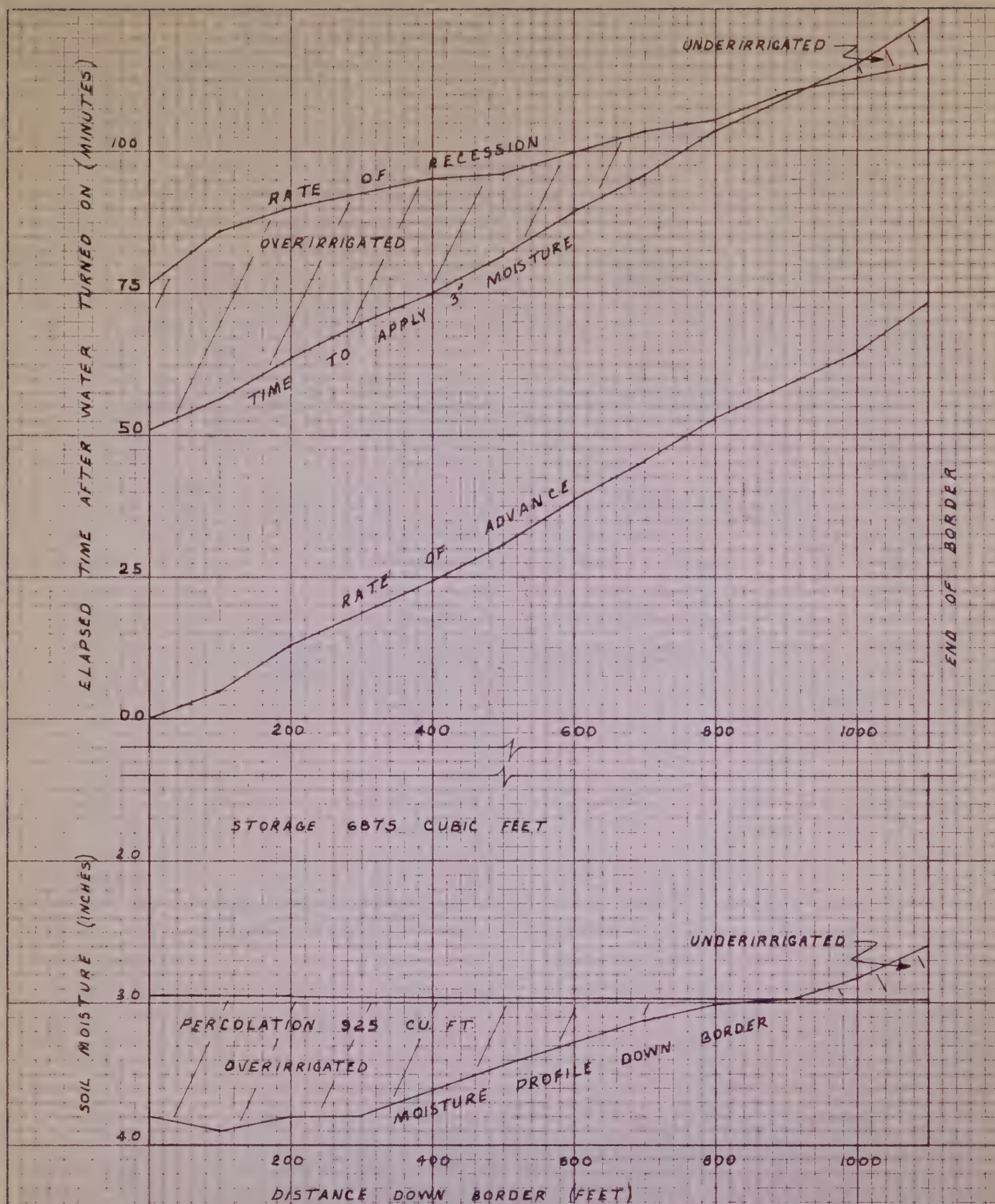
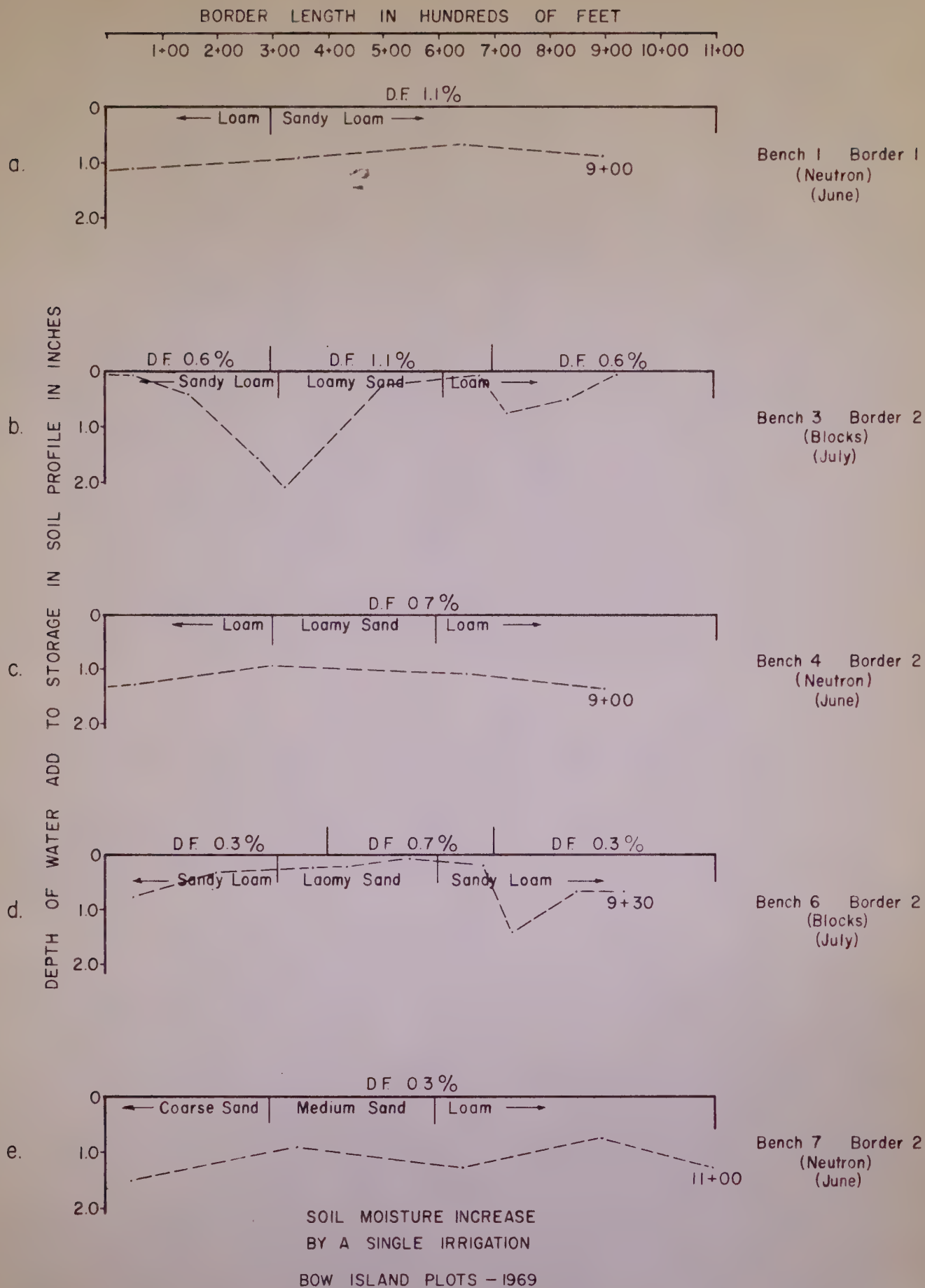


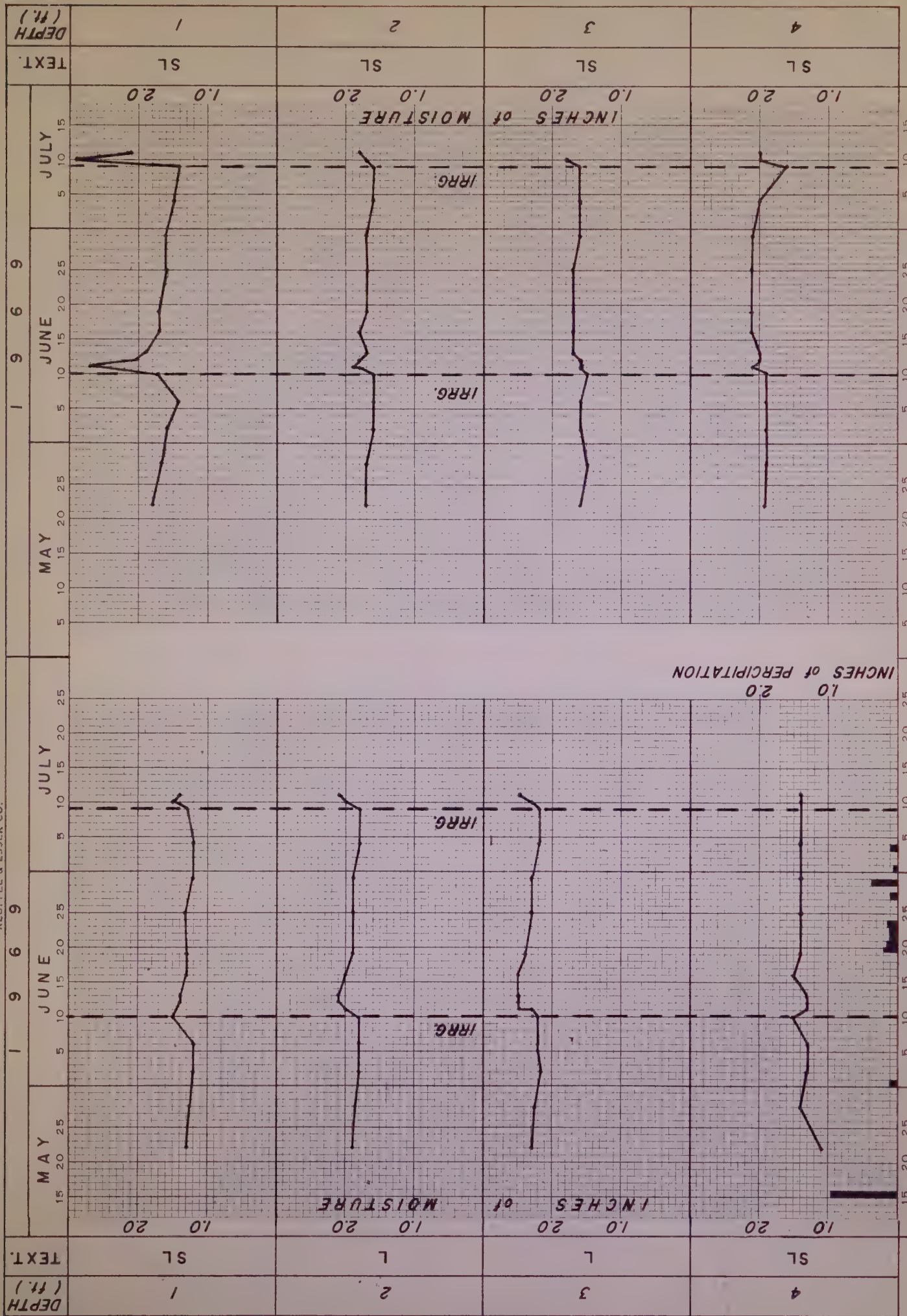
FIGURE 18  
BOW ISLAND PLOTS  
BORDER EVALUATION  
BENCH 8 BORDER 2  
JUNE 11/69







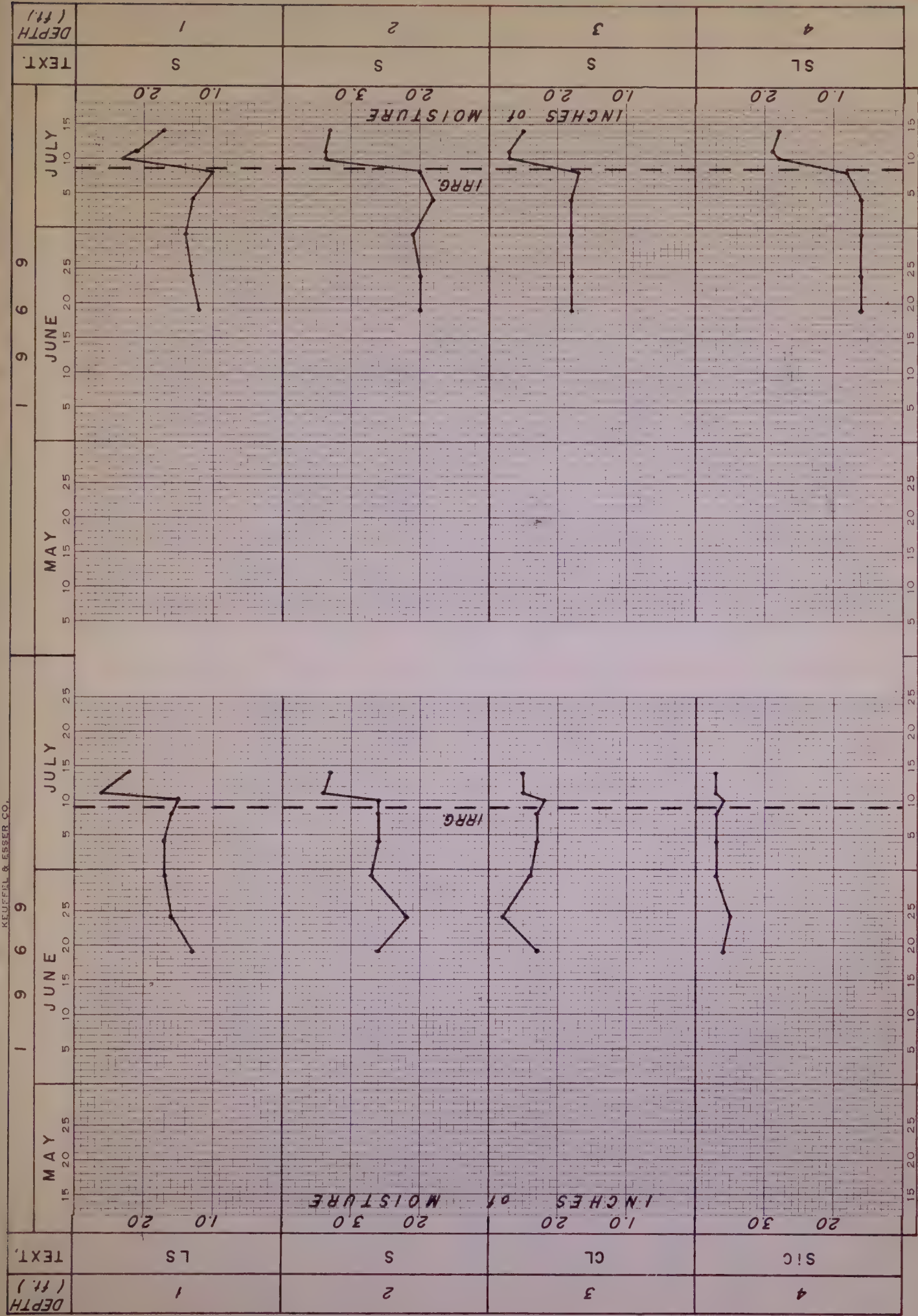




(a) STATION 18 50 BENCH 3 BORDER 2 INSTRUMENTATION: TENSIO METERS (b) STATION 38 30







(a) STATION 5 & 50  
 BENCH 5 BORDER 2  
 (b) STATION 8 & 30  
 INSTRUMENTATION: MOISTURE BLOCKS

FIGURE: 21

MAY 1970





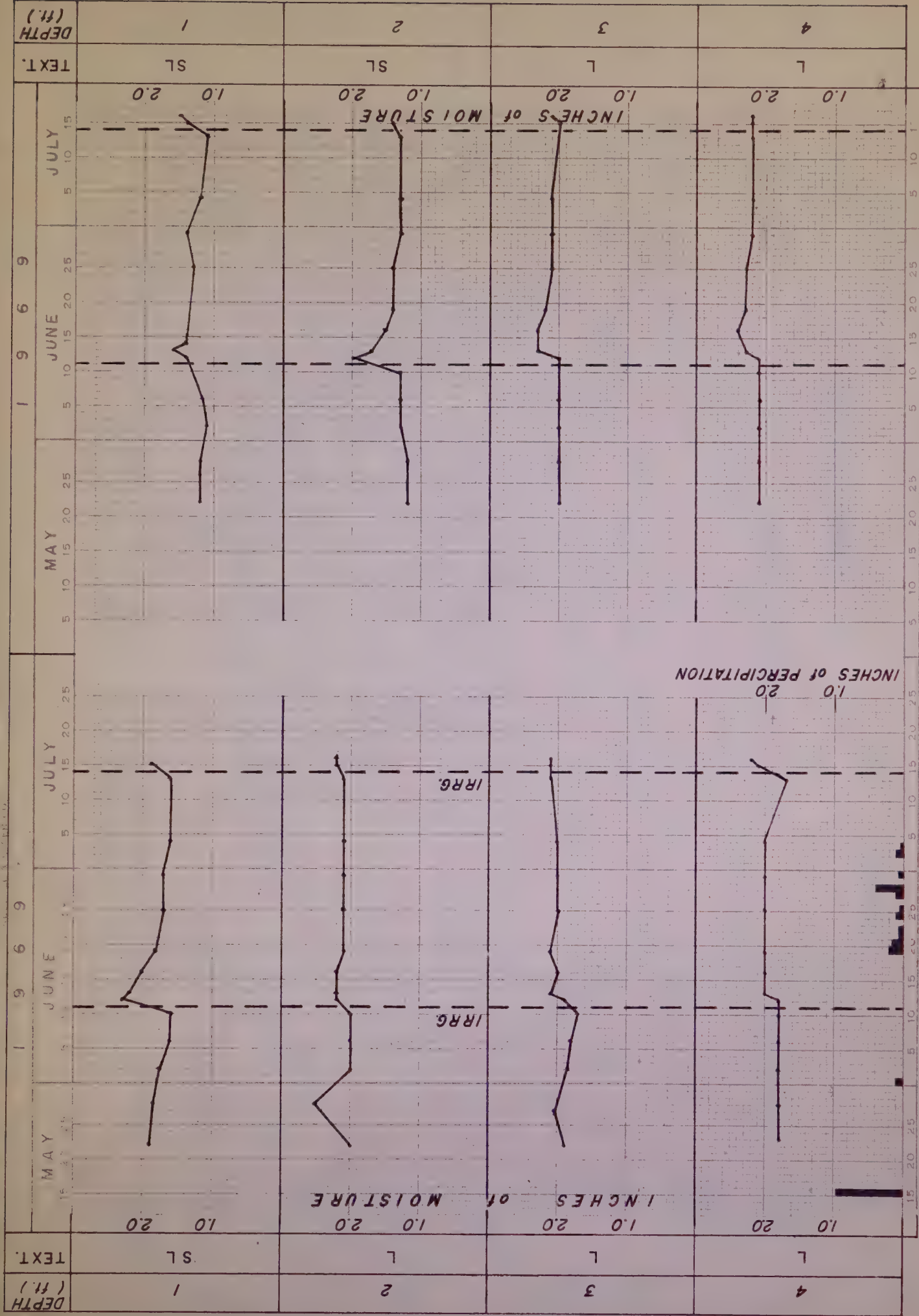


FIGURE 22 (a) STATION 08 50 BENCH 6 BORDER 2 INSTRUMENTATION: TENSIOMETERS (b) STATION 88 30





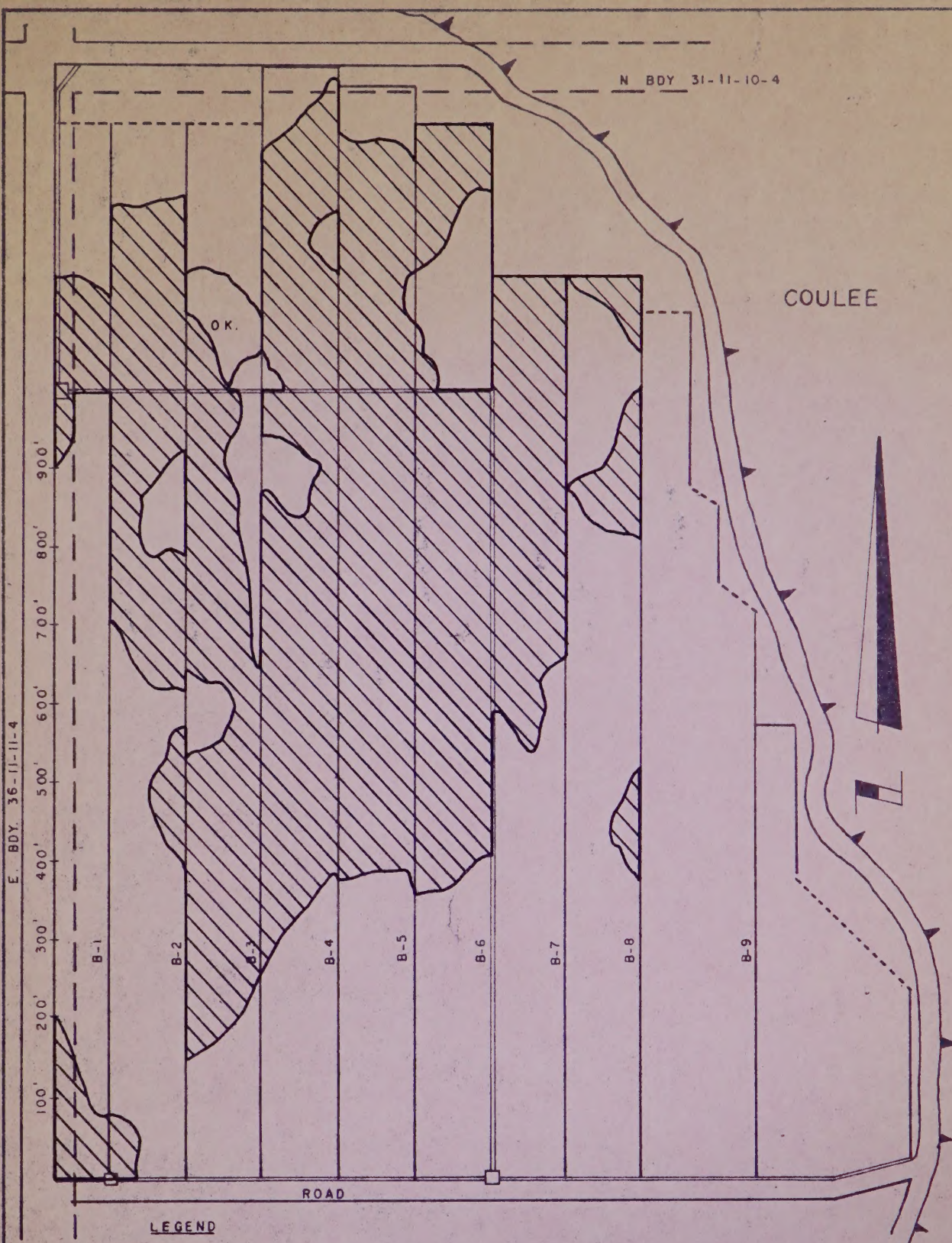


FIGURE 23



ALBERTA DEPARTMENT OF AGRICULTURE  
WATER RESOURCES DIVISION  
AGROHYDROLOGY BRANCH



BOW ISLAND TEST PLOTS  
LAND LEVELLING  
CUT and FILL AREAS

Submitted by \_\_\_\_\_  
Date \_\_\_\_\_  
Approved by *Elen L. Steel*  
Date *May 20, 1970*

Designed by \_\_\_\_\_  
Drawn by *T. ANDROSOFF*  
Checked by *[Signature]*

Date: APRIL 21, 1970

Sheet of

Scale: 1" = 200'

File No. C8-M-1-K-32











